©CIB579650

VOLUME VIII APRIL, 1923 NUMBER 2

JOURNAL
OF THE
American Association
of
Cereal Chemists

LIBRARY OF CONGRESS
25
1923
SERIAL DIVISION

OFFICIAL PUBLICATION OF THE
AMERICAN ASSOCIATION OF CEREAL CHEMISTS

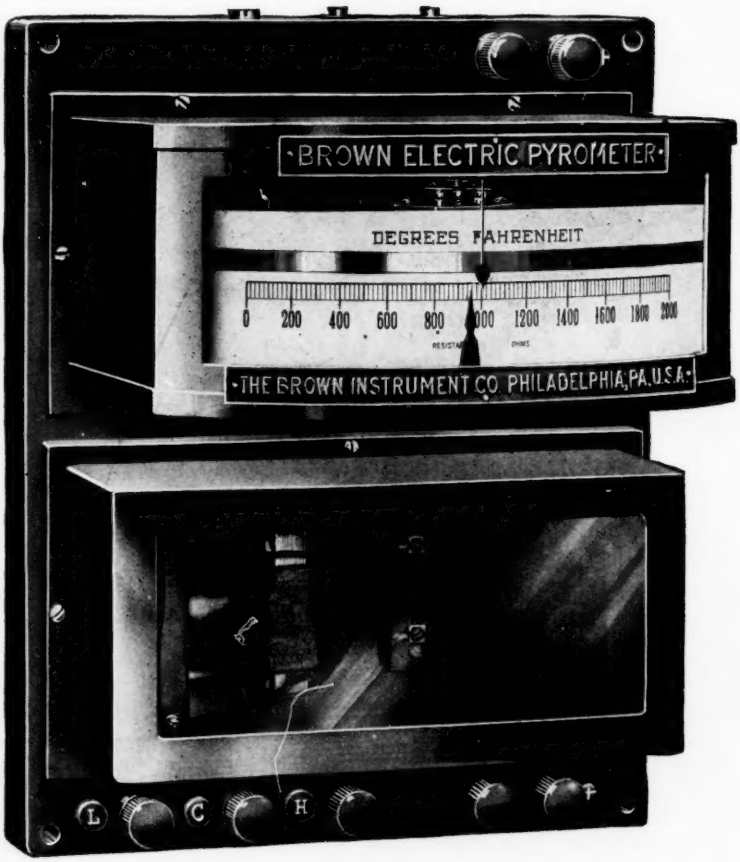
CONTENTS

Page

Varieties of Durum Wheat for Semolina Millers—
L. H. McLaren ---- 62
Some Notes on the Determination of Protein—
R. B. Potts ---- 66
Self-Rising Flour—L. Moher ---- 69
Some Notes on Phosphates for Self-Rising Flour—Paul Laidley ---- 72
Texture vs. Protein Content vs. Kernel Weight—W. L. Frank ---- 74
Some Observations on the Seasonal and Sectional Changes
in Kansas Wheat—Roy V. McVey ---- 82
Infestation of Cereal Products by Insects and Methods
of Control—J. C. Wood ---- 86
Of How Much Value is the Protein Test—Leslie R. Olson ---- 91
Relation of the Cereal Chemist to the Baking Industry—
E. B. Clark ---- 94
Meeting of Kansas Millers' Club, Chemists' Round Table—
April 14, 1923 ---- 100

PUBLISHED QUARTERLY
AMERICAN ASSOCIATION OF CEREAL CHEMISTS
HUTCHINSON, KANSAS

Price, net postpaid, per volume { $2.00 United States, Mexico, Cuba; $2.25 Canada; $2.50 Other Countries



Brown Automatic Temperature Control

FOR ELECTRICALLY HEATED FURNACES

This equipment consists of a thermo-Couple in the furnace connected by two wires to the Automatic Control Pyrometer. It automatically maintains a constant furnace temperature eliminating the many uncertainties of hand control. It is particularly adapted for flour ash determinations, anl is successfully used in many flour mill laboratories.

For further details write for Catalog No. 85.

Kansas City Laboratory Supply Co.

729 Holmes Street Kansas City, Missouri

JUN 25 1923

THE JOURNAL

OF THE

AMERICAN ASSOCIATION

OF

CEREAL CHEMISTS

Published by the American Association of Cereal Chemists.
Copyright 1922 by the American Association of Cereal Chemists

VOL. VIII April, 1923 No. 2

Advertising Manager ---------- R. S. Herman
Editor ---------- J. R. Hess

SUSTAINING MEMBERS

International Milling Co.----------New Prague, Minn.
Weber Flour Mills Corporation----------Salina, Kansas.
The Shellabarger Mill & Elevator Co.----------Salina, Kansas
The Robinson Milling Co.----------Salina, Kansas
The H. D. Lee Milling Co.----------Salina, Kansas
Western Canada Flour Mills Co., Ltd.----------Winnipeg, Man., Canada
Gooch Milling & Elevator Co.----------Lincoln, Nebr.
Wichita Milling and Elevator Co.----------Wichita Falls, Tex.
Larabee Flour Mills Corporation----------Kansas City, Mo.
Southwestern Milling Co.----------Kansas City, Mo.
The Fleischmann Co.----------New York, N. Y.
Ismert-Hincke Milling Co.----------Kansas City, Mo.
El Reno Mill & Elevator Co.----------El Reno, Okla.
Texas Star Milling Co.----------Galveston, Texas
Kansas Milling Co.----------Wichita, Kansas
Portland Flour Mills Co.----------Portland, Oregon
The Hoffman Mills----------Enterprise, Kansas
V. H. Noury & Van der Lande, Novadel Processes----------Buffalo, N. Y.
Wichita Flour Mills Co.----------Wichita, Kansas
Milton-Hersey Co., Ltd.----------259 Portage Ave., Winnipeg, Man. Canada
Arkansas City Milling Co.----------Arkansas City, Kansas
Bernhard-Sterns & Sons, Inc.----------Milwaukee, Wisconsin
Arnold-Madaus Milling Co.----------Sterling, Kansas
Western Star Mill Co.----------Salina, Kansas
Societe Anonyme de Minoteries et D'Elevateurs A Grains
----------24 Rue Royale, Bruxelles, Belgium
Hecker-Jones-Jewel Co.----------New York City, N. Y.
Wallace & Tiernan Co., Inc.----------Newark, New Jersey
The Bakeries Service Corp., 4830 Drexell Bldg.---- ----------Chicago, Ills.

Varieties of Durum Wheat for Semolina Millers

By L. H. McLaren

"Pure Durum Wheat" is a subject that has been discussed very much among Durum Millers and Macaroni Manufacturers, and as the term "Pure Durum Wheat" is rather vague we have decided to enlarge upon the subject. In the last few years many new types of Durum Wheat have been grown. There are many of these types which may be considered as pure Durum Wheat of which some may be very undesirable for Semolina milling. The term "Amber Durum" means very little to the miller for it may or may not denote a Durum Wheat suitable for the making of Semolinas but depends upon the type and conditions under which it was grown.

The original Durum Wheats were imported from Russia and the last importation was probably about 1900. They may be divided into two groups:

I. Northern Russian Durum.
II. Southern or Mediterranean Durum.

Of the several types in the first group only two seem to have gained any importance. These two are the "Kubanka" and "Arnautka." It is hardly worth while to mention the Velvet Don, Black Don or Gharnovka. Of the Southern group only one has any importance, that is "Pellissier" but usually called "Peliss."

These Durum Wheats were brought to the United States and grown in the semi-arid regions of North and South Dakota. The climate in this part resembles very much, the climate in Northern Russia. As the Durum Wheat yielded well in these sections, it was then grown in other states of the Northwest until it now included Montana, Wyoming and Minnesota, as well as other portions of North and South Dakota. Durum Wheats are pre-eminently dry weather wheats and require a climate which is too dry for the ordinary spring wheat. Since the farmers in certain sections of North and South Dakota had received good return from their Durum Wheat, it was then grown in sections which were not so well adapted, and the result is that some of the Durum Wheat grown is not as good a quality as required for Semolina or Macaroni purposes.

It is from these original types or selections that our present supply of Durum Wheat comes. The question has often been raised if these types deteriorated from the original type imported from Russia. It is our opinion that in general they have not while it may be that one year due to soil or climate conditions that may not be as good as other years but these are not heredity qualities and as soon as the seed is grown under the proper conditions they return to the original type. As mentioned before, there are sections in North and South Dakota which resemble the climate in Northern Russia and it is for this reason that these types retain their essential characteristics.

In a Bulletin published by South Dakota Agricultural College Experiment Station reports "the different varieties of macaroni wheat as grown with us vary most markedly from one another in their characteristics." The study of the essential characteristics seem to have been given little consideration. The main point in the wheat breeders mind seems to have been the yield or the bushels per acre and the quality for macaroni manufacturing has been somewhat overlooked. It can easily be seen that

the wheat grower should not lose sight of the quality factor as it is as important as the yield. It has only been lately that they have taken any great interest along this line. As a consequence several new types have been produced which have not proven satisfactory as they were not carefully tested for their macaroni qualities.

In comparing types of wheat it is necessary to compare a number of samples as any type grown under various conditions varies considerable. Thus it is not uncommon to find a single sample of a given type, for example "Kubanka" which has poor qualities although the average of the samples of this type is very good. It is not until we have examined a number of samples belonging to a given type grown under different conditions before any conclusions can be drawn.

Before going further it may be well to give what points are considered in judging Durum Wheat for its quality or how we determine what is suitable for macaroni purposes. There are four factors which are usually considered, yield—gluten—absorption and color.

By yield here we mean the amount of flour or Semolinas obtained from the wheat. The yield is governed somewhat by the weight per bushel and the soundness of the wheat. A wheat that is sound, hard and vitrous will make considerable more Semolinas than a soft, starchy wheat.

The gluten is an important factor in the manufacture of macaroni. The percentage of gluten should be high so as to make a strong Semolina. If there is insufficient gluten in the Semolina then the macaroni will break during drying and cause considerable loss.

The absorption is a factor that cannot be overlooked in the manufacture of macaroni. Each manufacturer has his definite absorption and any deviation from it may cause him trouble. It is necessary that the absorption be uniform. A high absorption is not an advantage but rather a disadvantage in Semolinas as the higher the absorption the more drying and longer time to dry the product.

The color is the most important factor of any. For while other factors may be satisfactory and if the color is not desirable then the wheat would have to be rejected for macaroni purposes. By the color we do not mean the color of the wheat but the color of the manufactured product. The color that is desirable in the macaroni is somewhat dependent upon the individual manufacturer and varies from light yellow cream to a clear yellow amber. The most objectionable color is a very pale or gray color, also a dark or brownish color. The trade has been taught that a macaroni with a dark or dull color is made from a low grade Durum flour.

The milling of Durum Wheat for Semolina consists in making coarse Middlings free from bran and germ. The size of the granulation is not standard but varies according to the purpose for which it is to be used. It is necessary that the Semolinas be absolutely free from any foreign material as a well manufactured macaroni is almost transparent and any foreign material can easily be seen in the manufactured goods.

The types of Durum Wheat were obtained from various States Experiment Stations and through the co-operation of J. Albin Clark, Charge of Western State Wheat Investigation, U. S. Dept. of Agriculture, Washington, D. C., samples were obtained from the following stations: Archer, Wyoming; Moccosin, Mont.; Mandan, N. D.; Dickinson, N. D.; Fargo, N. D.; St. Paul, Minn., and many others from various points in North and South Dakota and some from Canada. The samples represent wheat from

the sections where most of the Durum Wheat is grown. Most of these samples represent the 1921 crop while a few were from the 1920 crop.

Variety	Where Grown	Gasoline Color Value	Pekar Color Score	Moisture	Crude Protein	Wheat Notes
Kubanka	Archer, Wyo.	1.21	90	9.9	17.5	Bleached and Dull color.
"	Moccasin, Mont.	1.98	100	10.2	13.6	Bright Amber, some soft.
"	Mandan, N. D.	.93	92	10.7	20.6	Dull Gray, shrunken berries.
"	Dickinson, N. D.	1.24	93	10.0	20.2	Fair, bright color—12 per cent reddish.
"	St. Paul, Minn.	1.19	93	10.6	13.9	Weathered black tipped fungus.
"	St. Paul, Minn.	1.42	90	9.6	13.5	Fair Amber—15% Spring.
"	Werner, N. D.	1.61	100	10.3	13.0	Bright Amber.
"	Fargo, N. D.		95	10.0	14.0	Pale Amber.
"	McPherson Co. S. D.		95	11.0	13.4	Bright Yellow—12% Red D.
"	Faulk Co., S. D.		90	11.0	15.48	Pale Yellow—24% Spring.
" (Pierson)	Clearmont, S. D.		100	11.5	15.2	Very bright Amber.
"	Groten, S. D.		95	11.7	14.6	Bright Amber.
Acme	Groten, S. D.		80	11.6	15.8	Dull Amber.
"	Hyde Co., S. D.		83	11.8	17.3	Dull Amber.
"	Hoaken Co., S. D.		82	12.0	13.4	Dull Amber.
"	Walworth Co., S. D.		80	10.7	15.48	Dull Amber.
"	Archer, Wyo.	.85	80	10.0	19.0	Bleached Dull.
"	Moccasin, Mont.	1.37	88	10.6	12.2	Fair Amber, slightly dull.
"	Dickinson, N. D.	.64	82	11.8	19.8	Dull.
"	Mandan, N. D.	.75	83	11.4	19.1	Dull Gray.
"	St. Paul, Minn.	.94	83	10.6	13.6	Weathered and black tipped fungus.

In the above table is listed the following types of Durum, Kubanka,

To make the Pekar Test the Semolinas were reduced to flour and compared

Monad	Archer, Wyo.	1.08	80	10.8	16.4	Bleached—dull.
"	Moccasin, Mont.	1.31	90	11.0	13.2	Good Amber—slightly dull.
"	Mandan, N. D.	.70	87	11.5	19.8	Dull gray—small kernels.
"	Dickinson, N. D.	.86	87	11.1	20.0	Fair color—slightly dull.
"	Weseco, Minn.	.83	83	11.3	14.1	Weathered and sprouted.
"	Fargo, N. D.		78	11.8	17.5	Dark, dull gray.
Pelliss	Archer, Wyo.	1.50	97	11.3	14.7	Bright amber—large berries.
"	Moccasin, Mont.	1.52	98	10.8	13.0	Bright Amber—large berries.
"	Mandan, N. D.	.98	90	11.3	20.2	Fair Amber—long, shrunken berries.
"	Dickinson, N. D.	1.03	96	10.2	20.8	Bright Amber—large berries.
Mindum	Fargo, N. D.		100			Bright Amber.
"	St. Paul, Minn.	1.50	96	10.8	12.9	Fair color—black tipped fungus.
"	St. Paul, Minn.	1.62	99	11.1	13.3	Bright color.
"	Coon Creek, Minn.	1.46	98	11.4	12.3	Good color.
Red Durum	Fargo, N. D		80			Dull, brownish color.
"	Archer, Wyo.	1.08	85	11.1	13.2	Dull dark yellow.
"	Moccasin, Mont.	1.45	86	10.1	13.8	Dull dark yellow.
"	Dickinson, N. D.	1.04	83	11.3	20.1	Dull dark yellow.
"	St. Paul, Minn.	1.05	80	11.4	14.3	Bleached and black tipped fungus.
Arnautka	St. Paul, Minn.	1.17	90	11.2	14.7	Damaged and black tipped fungus.
"	St. Paul, Minn.	1.45	94	11.2	14.1	Fair Amber.
"	Fargo, N. D.		97			Slightly pale amber.
	AVERAGES					
Kubanka 12 samples		1.37	94	11.2	16.0	
Arnautka 3 samples		1.32	94	11.2	14.4	
Pellis 4 samples		1.26	95	10.9	17.2	
Acme 9 samples		.93	82	10.9	15.8	
Monad 6 samples		.96	84	11.1	16.7	
Red Durum 4 samples		1.16	83.5	10.7	15.4	
Mindum 4 samples		1.53	97.7	11.4	12.8	

Arnautka, Pellis, Acme, Monad, Red Durum and Mindum. These samples were milled on a smaller experimental mill and the Semolinas obtained.

with a sample which we called standard and scored as 100. The gasoline color value was determined on some of the samples but there was no attempt to connect the gasoline color value and Pekar score.

Conclusion

Kubanka and *Arnautka* are old types of Durum and are of very good quality and very satisfactory for manufacture of macaroni.

Pellis is a large berry and has very good color but there is a rather small amount of this type grown.

Mindum is a selection from Arnautka and seems to give very good results. This is a little more rust resistance than Arnautka.

Acme and *Monad* were developed for their rust resistance qualities. They have proven very poor for macaroni manufacture as they produce a product with a very poor color.

Red Durum is very undesirable for the manufacture of macaroni and cannot be considered as a macaroni wheat.

Pillsbury Milling Company, Minneapolis.

Some Notes on the Determination of Protein

By R. B. Potts

A few months ago a meeting of the chemists of the state of Kansas was called by the mill owners for the purpose of seeing if the chemists could not find or devise means by which different chemists and laboratories could check more closely upon their determinations. Especially did this seem true of protein, moisture and ash; the three fundamental analysis of a cereal chemist. In view of this fact and also the fact that the grain firms within the past year have nearly unanimously adopted protein content as a selling basis for their wheat, I have undertaken to bring to light a few features and facts in regard to the determination of protein.

To those who did not receive samples of the flour which were sent out, I will repeat the questions that were sent along to be answered, as well as the result obtained upon the flour.

1. What method of nitrogen determination was used. State the reagents used and amounts of each.
2. Approximate time of digestion.
3. Approximate time of distillation.
4. Capacity and type of flasks used.
5. How much correction do you use as determined on blank.
6. Do you distill your ammonia into an excess of acid.
7. What normality of solutions were used.
8. Do you standardize your acid or alkali.
9. State method and reagents used in the standardization.
10. Have your burettes been standardized with a Bureau of Standard burette.

Twenty-five samples were sent out and twenty-one replies received. One of the four, who did not send in results answered my letter and had a good excuse; as for the other three, I hope they will call on me when they want a little work done sometime in the future.

The average of the protein results reported was 10.6. The highest results was 10.95% and the lowest 10.28%, a variation of practically 0.7, which seems to me to be entirely too great upon the same sample of flour sent out in a sealed container. No samples were sent to commercial laboratories but all went to our own members, picked at random.

In answer to the first question as to the method of determining the protein, five variations were reported.

9 used copper wire and sodium sulphate.

5 used copper sulphate mixed with a sodium sulphate.

5 used metallic mercury with the sulphate.

1 used mercuric oxide and sodium sulphate.

1 used mercuric oxide sodium sulphate and copper sulphate.

I have divided the results into the four following classes:

Those using copper wire and sodium sulphate averaged 10.53, grates varied 0.4.

Those using mercury and sulphate averaged 10.64, grates varied 0.18.

Those using copper sulphate averaged 10.5, grates varied 0.4.

Those using mercuric oxide and sulphate averaged 10.88, grates varied .15.

This shows that both copper wire and copper sulphate tend to give the lowest results, 10.5 in both cases. This was found true in our own laboratory. The results checking .1 lower than with our regular method using metallic mercury, which averaged from the questionnaire, gave 10.64. Only two used mercuric oxide but their returns were very high, one reporting 10.95 and one 10.8 for an average of 10.88. In our own test the flour averaged 10.8 with mercuric oxide. The average amount of sulphuric acid used was 17 c. c. The majority using 15 c. c. The amounts of sodium sulphate used varied from 2 grs. to 12 grs. for an average of 7 grs. I have found if over five grs. are used the sulphate will crystalize on cooling, sticking to the wall of the flask and causing a great deal of delay in getting them back into solution again for the distillation.

This really laps over into the second question, the time of digestion, for we all know the amount of sulphate regulates the time consumed in this process. The time varied from 20 to 90 minutes, for an average of 50 minutes. The boys that used 10 grs. or more of sulphate had an average of 47 minutes. Those who used 15 c. c. of sulphuric acid averaged 44 minutes. So this seems the secret to the shortest time, altho we all know the amount of heat is a paramount factor along this line; but it was not deemed advisable to try to get the temperature at which the digestion took place. Those who use Gilmer Heaters and so indicated it on their report showed an average of 37 minutes, the fastest time yet, so this is another argument in their favor. The protein reported by those who took 50 minutes or over for their distillation was 10.63. Those who took less than 50 minutes averaged 10.5. This is not as great a variation as might be expected, it does show what many of us have long contended that a digestion carried on at too high a temperature or in too short a time is liable to volatize some of the ammonium sulphate and get lower results; but at the same time a loss of 0.1 is easily within the limits of experimental error, and could easily be sacrificed for the sake of its quickness.

Question No. 3. The time of distillation can have very little to do with

a protein result, hence we pass over this question by saying the time ranged from 20 to 60 minutes for an average of 37 minutes.

Question No. 4. As to the type of flasks used; 20 use long neck kjeldahl and one the globe flasks with short neck. 15 used 800 c. c. flasks and six 500 c. c. flasks. Showing the majority use the larger 800 c. c. flasks.

Question No. 5. The amount of correction used. This varied from 0.6 c. c. of 10th normal acid to zero for an average correction of 0.2 of a c. c.

Question No. 6 was answered. *Yes,* unanimously, all distill their ammonia in an excess of acid, thats one thing we have all learned about a protein determination.

Question No. 7. In regard to the normality of solutions used, 19 used tenth normal solutions, one used N-20 and one N-10 Sodium Hydroxide and N-5 sulphuric acid. Neither of these two turned in 10.6 protein on the sample of flour.

Question No. 8. Asking whether the acid or alkali were standardized, 15 standardize the acid, 5 the alkali, and 1 standardizes both. The 15 acid standardizers reported a protein content of 10.62 and the 5 others reported an average of 10.5. Showing a tendency to run lower upon the alkali standardization.

Question No. 9. State wat method of standardization was used. Thirteen used the barium chloride method. Three used potassium-pi-tartrate in the alkili standardization. Two use sodium carbonate. Two oxalic acid and one Benzoic acid. Those using barium chloride averaged 10.63% protein upon the sample. Those who used the potassium acid tartrate method averaged 10.48. Sodium carbonate 10.5. Oxalic acid 10.65 and benzoic acid 10.28.

Regarding question No. 10, eight have had their burettes standardized with a Bureau of Standard Burettes and thirteen have not. I thing every laboratory should possess a standard burette. It makes for accuracy and there is nothing so discouraging to a chemist or more bewildering at times than a faulty burette. I have found that the high grade burettes like Schellbachs will check practically perfect, but many of the plain, common variety will be found as high as .06 to .07 c. c. error in 50 c. c. So myadvise is get a standard burette and play safe.

As to the conclusions to be drawn, no one thing stands out worthy of recommendation, neither is there one particular method or practise to be condemned. We cannot get away from the fact that there is a large personal element in chemistry; even if it is termed an exact science; and this has probably more to do with the results of this laboratory and that one than all the above mentioned items. We are all aware of the fact that there is room for improvement in the results and checks along the line of our protein determinations here in our own association; and when you step outside of it and meet some of the protein analysis, well, the problem is a momentous one. I have jotted down a few things that have come to light in this work and a few of my own personal views on what I have seen in protein determinations. I think a point here and a point there taken up, or rejected will bring us to a closer check of protein.

As regards the method used, why not decide on one particular method and adopt it. It does have some influence as has been seen. The use of copper wire or the sulphate gives 0.1 lower result than the mercury. Mer-

curic oxide gives too high a determination. I have used all the methods heretofore stated and I have always ended up by going back to metallic mercury and sodium sulphate. The variation in those using this method was only 0.18 compared to 0.4 by the copper method. However, I don't stand as an authority upon the merits of the case, but am governed only by my work and the results here reported. Another factor to be considered is the time alloted to make a correct protein test, and the proper amount of acid, sulphate, copper or mercury to get the reaction complete in the shortest, accurate time. I would like to hear this considered by the association in open meeting.

We all use long necked kjeldahl flasks, we use the proper correction as shown on our blanks to comply with our own local conditions. We use N-10 acid, at least the majority do and we distill our ammonia into an excess of acid. But this acid is standardized by five different methods, all probably equally good in themselves but not when it comes to checking another operator in a distant part of the country who uses another entirely different method of standardization linked with a little of his own personal element of individuality. I am not prepared to say which method is the best, new ones are coming out and being developed all the time. If some one has the latest and best lets hear about it. At present the majority use barium chloride, and weigh the precipitate of barium sulphate. This is a trifle tedious but any one who says he cannot run a barium sulphate and do it correctly does not deserve the name of chemist in my estimation.

Then there comes the standardized burettes, good materials, balance correctly operated, condenser tubes not leaking, tight fitting stoppers to fit the various shaped and sized mouths we get on our kjeldahl flasks today and various other wrinkles that come by experience.

And now in conclusion there are two things that stand out clearly in my mind that we should get together, discuss and agree on; first a standard method of nitrogen determination, and second, a uniform method of standardizing our normal solutions.

The Wichita Flour Mills Co., Wichita, Kansas.

Self Rising Flour

By L. Moher

In looking over Chemical Abstracts of the last six years the author was surprised to find that self-rising flours and calcium acid phosphate are not treated in a liberal way at all. Outside of a few recent articles there is not much said on the subject. In connection with soft wheat self-rising flours the author has found the following few notes of quite a little help. These notes contain nothing new or novel, only a little review of the methods of analyses as used in the self-rising flour industry.

The principal ingredients of self-rising flour are acid phosphate, salt and soda.

Calcium acid phosphate, sometimes called calcium bi-phosphate, superphosphate, primary calcium phosphate, is used to liberate carbon dioxide from the sodium bicarbonate. Hence the stronger the phosphate the more

carbon dioxide it will liberate; hence phosphate companies make this a great talking point.

There are several methods of determining the neutralizing power of acid phosphate. The results are always calculated in a number of parts, $NaHCO_3$ neutralized by 100 parts of acid phosphate.

The method used by a number of large manufacturing companies of phosphate depends upon the addition of an excess of alkali and is as follows:

Weigh up 0.8401 grams of Phosphate, add 25 c. c. of cold water and stir. Then run in 90 c. c. of .1 N caustic soda from burette, bring to a boil and boil 1 minute. Add phenolphthalein as indicator and titrate back 0.1 N Hydrochloric acid. The amount of HCL required to cause the pink to disappear taken from 90 c. c. of alkali used gives the neutralizing value of the phosphate in terms of sodium bicarbonate and is expressed in units.

The other method used is to titrate the phosphate direct. This method is recommended by W. E. Wadman in December issue of Journal. Ind. & Eng. Chemistry. Wadman has quite a lengthy discussion of the chemical considerations of the direct and indirect titration of phosphate. The indirect titration will give higher results than the direct method by quite a large percentage. For the discussion the reader is referred to the above article.

The manufacturer claims that direct titration is not reliable and the results cannot be counted upon for an application to practical baking operations.

The author has no research data to support either of these claims only a reference by Clark that primary calcium phosphate cannot be analyzed by titration. According to Clark the reaction of sodium bicarbonate and phosphate depends upon the concentration of the hydroxyl ion. Liberal excess of bicarbonate causes the tertiary calcium phosphate to form.

Another method is to titrate in a 40% solution of calcium chloride, direct. The author thinks that it would be a good idea if the American Association of Cereal Chemists would take this matter up and appoint a committee to get some reliable data on the same.

The next big item in phosphate testing is free phosphoric acid. Free phosphoric acid causes premature action in self-rising flours. The only condition under which Acid calcium phosphate is hydroscopic is in the presence of free phosphoric acid. The reader is referred to the research work by Stakolsa, Sommers and others on this subject. A phosphate being hydroscopic, takes water from the atmosphere and causes a premature action to go on between the phosphate and soda. This action produces carbon dioxid and water. This water gives room for more action and as a general rule the self-rising flour will become rancid; hence free phosphoric acid should be guarded against as a small amount will cause trouble.

The following method for its presence is used by a large firm. It is a simple and quick method:

Weigh up 1 gram into a casserole, add 50 c. c. distilled water titrate immediately, using methyl orange as an indicator. There should not be more than a trace of free phosphoric acid present.

The following are of less importance than the above:

Arsenic should not be present in large amounts in phosphate to be used in self-rising flours. About 1.43 parts per million should be the limit according to McFadden. During the war, some phosphates were found

in England containing as high as 400 parts per million. Phosphate of this sort is not suitable for self-rising flours. All the phosphates found containing large amounts of arsenic were of English make. The arsenic came from the use of impure chamber acid in the manufacture of phosphates.

Arsenic is determined by the Marsh Test or Munktells method.

Lead is usually present in small amounts. It also comes from the use of impure chamber acid. It is detected by the method of Chittick.

Flourine is generally present in small amounts and is determined by the method of Ross. This method will give low results but Mr. Ross. hopes to overcome this by using a different shape flask.

There are a number of other chemicals always present in small amounts and as a general rule are in such small amounts that they are not harmful.

Sodium Chloride. Most Sodium chloride on the market is suitable for the manufacture of self-rising flour although quite a range of inequality of the salts from various parts of the country.

Salt containing much Magnesium chloride should be closely guarded against as this impurity is hydroscopic and will have a tendency to cause a premature action of the soda and phosphate.

Some salts contain added ingredients to stop them from caking. These should be taken to account when making up a formula for self-rising flour as some are acid and some basic.

The quantitative determination of sodium chloride: dissolve a known amount of salt in distilled water and titrate with 0.1 $AgNO_3$ using K_2CrO_4 as an indicator. One c. c. of 0.1 N $AgNO_3$.

Sodium Bicarbonate: The author has never experienced any trouble with soda. Most of it coming to his attention was suitable for use in the selfrising flour industry. The quantitative determination as follows: Weigh up a known amount of dried soda, dissolve the same in distilled water and titrate with 0.1N acid using methyl orange as an indicator. I c. c. equals .005846 grams NaCl. 0.1 N acid equals .008401 grams $NaHCO_3$.

The self-rising flour itself is certainly a problem that is yet to be solved. The papers on the same and research work is indeed too much. From all appearances the self-rising flour industry is on the increase and will continue to increase. It seems from the most part that a number of mills just mix the ingredients together and forget all about testing the finished flour. This is indeed a mistake. While the ash and color may be all right on the unmixed flour there is no control as to what the flour will self-rising flours as to their neutrality.

The color and texture of each batch of biscuits should be noted. The biscuits made are then broken open and spotted with indicators. Phenolphthalein should always give a neutral reaction. Methyl orange should give a slightly alkaline reaction. In a recent magazine article a writer called the special attention of the public to note that most self-rising flours contained an excess of phosphate to make up for the pinch of soda to be added by the housewife. The author does not think that this is the truth; but does think that we should be a little more careful about the analysis of rising flours as to their neutrality.

Another good method to make biscuits is to use a standard formula and bake the biscuits in a baking cylinder, this will give the actual leavening efficiency of the ingredients used.

According to Weil an alkaline reaction is desired, but he advises that the excess of bicarbonate should never be greater than 1% under any conditions. A very alkaline reaction would indicate too much soda and an acid reaction would indicate too much phosphate. The author knows of no test for an excess of salt except tasting the biscuits.

According to the above, a good self-rising flour should contain about 300 gams of carbon dioxide per barrel of flour. But Weil makes no distinction between the different flours as hard, soft spring, patent, clear or low grade. Since most flours vary in chemical composition, it is highly probable that different amounts of leavening agents should be used.

The quantitative determination of carbon dioxide in self-rising flour is very unsatisfactory and beset with many difficulties. The following two methods have been recently tried and their authors claim them to be very reliable. They are as follows:

Hallett Method: The carbon dioxide is removed from the self-rising flour by means of a current of carbon dioxide free steam, the liberated carbon dioxide is absorbed and determined as usual.

Jacobs Method: The carbon dioxide is removed from a dried sample of flour treated with diastase by means of a current of carbon dioxide free air.

While the author has never tried any of the above methods to determine carbon dioxide they sound well and should be given close attention and study.

The author has found these few notes of help to him in testing self-rising flours and believes that a lot of work can be done along the line of figuring out some quick laboratory test for self-rising flour.

Larabee Flour Mills Corporation, Clinton, Mo.

Some Notes on Phosphates for Self-Rising Flour

By Paul Laidley

The purpose of using bicarbonate of soda in self-rising flour is to secure the benefit of the release of the carbonic gas from this soda. The release of this gas causes the baking to become aerated and permits of a thorough cooking within the oven product. This carbonic gas is released by use of a phosphate which is used in indirect ratio as it neutralizes bicarbonate of soda.

We will only consider a definite amount of soda—that amount which is universally used by the flour millers.

70 test formulae	75 test formulae	80 test formulae
200 lbs. flour	200 lbs. flour	200 lbs. flour
3 lbs. soda	3 lbs. soda	3 lbs. soda
4¼ lbs phosphate	4 lbs. phosphate	3¾ lbs phosphate
3 lbs. salt	3 lbs. salt	3 lbs. salt

If you base a uniform cost for the soda, salt and phosphate, then the cost of these formulae per barrel is as follows:

70 test formulae	75 test formulae	80 test formulae
$00.1220	$00.1120	$00.1020

Material costs are figured as follows:

Soda at 2.40 Salt at 2.00 Phosphate at 7.00 Flour at 3.00

Were a flour miller to produce 500 barrels of self-rising flour per day it would require $10.00 more to produce this flour on a 70 test formulae than on an 80 test formulae or $5.00 on a 75 test formulae.

This should illustrate that a phosphate which will neutralize bicarbonate of soda at a higher test and if properly used will be more valuable than one that neutralizes at a lower test.

Looking at the value of phosphates from another angle; using as example—two phosphates that have a difference in neutralizing value of 3¾%. The one testing 75% and the other 78¾%. These phosphates differ in value in dollars and cents to the amount of 5%. To illustrate: a difference in neutralizing strength of 5% in phosphates that neutralizes bicarbonate of soda at 50% and 55% would amount to a difference of 10% in value or worth in dollars and cents. That is, 10% more weight of the 50 test phosphate would be required to perform the function of the 55 test phosphate.

The difference in the baking result when two phosphates have a neutralizing differential of 3¾% on the scale of 80% is very slight and hard to determine in the baking. However, 5% less by weight, of the stronger phosphate would have the same effect in the baking. This 5% amounts to 35c per 100 lbs., on 7c phosphate. This would be illustrated by piling at random 20-25c pieces in one pile and 21-25c pieces in another pile. It would be hard to determine, merely by the eye, just which pile is of greater value. However, if you were to stack each pile or weigh each pile—then the comparison would be simple.

Chemical tests are not made by the eye—they are made by the use of a burette—which is a measure by which the value of a phosphate in neutralizing strength is attained.

Here we have spoken of a small differential of but 3¾% in neutralizing value on a scale of 80%. Some manufacturers are continually maintaining their neutralizing value at approximately 70-72%, whereas our own product is maintained at 80-82%—all values based on the same test. Surely the flour miller is interested in the differential in these values.

Based on this differential in neutralizing value and comparing a phosphate that is 80 test and costs 7c per pound with a phosphate that is 70 test. This latter 70 test phosphate is worth but 6⅛c per pound.

80:70:: 7:X

X equals 6.125

Is this not of interest to the flour miller?

To determine which formulae is most suited to the phosphate you are using or which phosphate is most suited to the formulae you desire to use, is not a difficult task if referred to your own consulting chemist. Samples should be drawn at once in duplicate from your present stock of Phosphate, you to retain one sample and submit one sample to your consulting chemist. Below is a method of making a titration, which means determining the neutralizing value of phosphate in units of bicarbonate of soda. If an analysis is required then your chemist can find the official method of determining the different chemical factors in the "Official Methods of Analysis" (Edition of 1920) which is published by the Association of

Official Agricultural Chemists, Washington, D. C.

NOTE—Some phosphates fade to a brown color if ept for four to six months. The duplicate sample you keep, when sending the sample to your chemist, will determine the color of your product if you keep this sample for aperiod of time.

METHOD OF TITRATING CALCIUM ACID PHOSPHATE

By Wm. G. Warning

A 0.8401 g. sample of the Phosphate is weighed accurately into a 300 c. c. casserole, 25 c. c. of distilled water and exactly 90 c. c. N/10 NaOH are added, and thoroughly mixed; one drop of 1% phenolphthalein solution is added; the sample is boiled for one minute; the sample is titrated while still boiling hot, by adding N-5 HCl, until the pink color, due to the indicator has all but disappeared and does not return in one minute. Then calculate: 90 2x (c. c. HC1 sol. used equals neutralizing strength of 100 parts of Phosphate in terms of Bicarbonate of Soda.

Data to show effect of addition of Phosphoric Acid to Mono-Calcium Phosphate upon total and free acid determinations.

100% H_3PO_4.	No. 1662		No. 1315		No. 1640	
Added	Total	Free	Total	Free	Total	Free
0	74.0	0.0	77.0	0.0	80.2	0.2
1	75.0	0.1	78.0	0.2	80.2	0.2
5	77.0	2.0	81.0	3.5	83.0	2.0
10	81.2	7.0	84.6	7.0	86.4	7.0

Texture Vs. Protein Content Vs. Kernel Weight

W. L. Frank, Chief Inspector, Grain & Cotton Ex., Sherman, Tex.

Introduction

The object of the experiment reported herein, was to determine what relation exists between protein content, texture and kernel weight. Twelve samples of Hard Red Spring Wheat grown in Northwestern Ohio in 1918, were used. Each sample was divided into six portions. Texture was the basis of classification in making the separations. The following determinations were made and recorded, namely,—number of kernels, weight per thousand kernels and protein content of each original sample, and of each of the seventy-two separations.

Texture

The Federal Grades for Wheat recognize only two degrees of texture, namely,—"*Dark Hard* and *Vitreous*" and "*Not Dark Hard* and *Vitreous.*" To the close observer, there are many more degrees and gradations apparent in the texture of wheat. It would be impractical and impossible to recognize every degree and each minute gradation between true d. h. and v., and soft and chalky. In the experiment under discussion, six degrees and gradations were recognized. They may be described as follows:—

1. *Dark Hard*: Entire kernel hard and vitreous and of a dark amber color.

2. *Hard*: Entire kernel hard and vitreous but not as dark kernel as "Dark Hard."

3. *Spotted*: At least four-fifths of exterior surface of kernel appearing hard and vitreous, and with a small portion—best described as a "spot"—appearing soft and chalky.

TABLE No. 1. Protein Content vs Relative Texture.

Protein Content (NX 5.7 = protein).

Sample	Relative Degrees of Texture						Average of six Portions	Original Sample
	Dark Hard	Hard	Spotted	Mottled	Yellow	Starchy		
A	12.56	12.28	11.48	10.66	1089	10.44	11.38	12.02
B	12.48	12.51	10.57	10.44	10.11	9.67	10.96	11.36
C	12.96	11.96	12.00	10.68	10.64	9.59	11.30	11.49
D	12.40	12.29	11.00	11.26	11.48	10.92	11.56	12.07
E	12.64	12.09	broke	10.07	10.36	broke	11.29	11.73
F	11.81	11.52	10.65	10.40	10.03	9.87	10.71	10.73
G	12.72	11.37	11.35	11.29	10.82	10.83	11.40	11.88
H	12.27	broke	10.36	10.17	10.01	9.92	10.55	10.40
I	13.76	13.12	12.82	11.58	12.68	13.01	12.83	13.21
J	13.12	12.94	12.85	12.59	12.24	12.32	12.68	12.81
K	12.32	12.03	12.27	11.64	11.64	11.11	11.83	11.81
L	11.84	11.84	11.01	10.12	10.05	10.34	10.87	11.01
Total of addition	150.88	134.95	126.36	130.90	130.95	118.02	137.36	140.52
Average	12.57	12.27	11.49	10.91	10.91	10.73	11.45	11.71

**Note: Three flasks broke while the determination of protein content was being made.

4. *Mottled*: More than one small spot or, more than one-fifth but not over four-fifths of exterior surface of kernel appearing soft and chalky.

5. *Yellow*: More than four-fifths, but not all of exterior surface of kernel appearing soft and chalky.

6. *Starchy*: Entire exterior surface of kernel appearing soft and chalky.

The classification adopted was entirely arbitrary. It represented as near as possible, the largest number of degrees of texture that could be recognized without making the distinctions so minute that they could not be readily recognized. Other reasons entered into the consideration. There are those who hold that one small spot of starchy endosperm should be classed as d. h. and v. Others contend that only the dark amber kernels of the d. h. and v. Others contend that only the dark amber kernels of the d. h. and v. type, are entitled to the premium usually paid for the subclass *Dark Northern* over *Northern*, etc.

Texture vs Protein Content

The protein content of each of the seventy-two (72) separates is given in Table No. 1. By combining *"Dark Hard"* and *"Hard"*, we have a texture classification corresponding to the present interpretation of *dark, hard and vitreous* kernels. The following points are brought out in Table No. 1, regarding relative texture, namely:—

(a) All "Dark Hard" separates contained more protein than did the original samples.

(b) Three-fourths of all "Hard" separates contained more protein than did the original samples, and in all samples except one, the "Hard" separates contained less protein than did the "Dark Hard" separates from the corresponding samples.

(c) One-fourth of the "Spotted" separates contained more protein than did the original samples.

(d) The protein content of any separate designated as "Mottled", "Yellow", or "Starchy", did not exceed that of the corresponding original sample.

(e) The averages for the six columns form a regular progressive series in which texture and protein content are shown to be closely related.

(f) On the basis of average protein content, "Dark Hard" separates were found to be superior to "Hard" separates, while "Spotted" separates were intermediate between "Hard" and "Mottled" separates in protein content.

From a grading standpoint it would appear that the present interpretation of *dark hard* and *vitreous* is approximately correct. Inclusion of the "Spotted" separates with "Dark Hard" and "Hard", would greatly reduce the value of *dark hard* and *vitreous* from a mixing and blending standpoint. The following tabulation (Table No. 2) will illustrate the effect of such a change:—

TABLE No. 2—Effect of including "Spotted" separates in dark hard and vitreous texture classification.

Dark Hard and Vitreous		Not Dark Hard and Vitreous	
Separates	Average Protein Content	Separates	Average Protein Content
Dark Hard	%	Spotted	%
Hard		Mottled	
		Yellow	
	12.42	Starchy	11.01
Dark Hard		Mottled	
Hard		Yellow	
Spotted	12.11	Starchy	10.85

The effect of including "Spotted" in the dark hard and vitreous classification would tend to reduce the protein content of both the *dark hard* and *vitreous,* and *not dark hard* and *vitreous* groups. The value of dark hard and vitreous would be so lessened as to reduce its relative market price. No permanent benefit would be derived from such a change in the market grades.

In no less than ten out of twelve samples, the separate having the lowest protein content was either yellow or starchy, and in the remaining two samples it was the Mottled separates that had the lowest protein content. The minimum range in protein content between separates from any one sample was 0.88 per cent, and the maximum was 3.37 per cent. The average range in protein content between separates of the same sample was 2.06 per cent.

Conclusion

1. There is a direct relation between relative texture and protein content.

2. The difference in protein content of "Dark Hard" and "Hard" as contrasted with "Spotted", does not warrant including the latter in the interpretation of dark hard and vitreous, although the "Spotted" group is admittedly superior to other groups more starchy in appearance.

3. The data presented justifies the present interpretation of dark hard and vitreous as used in the commercial grading of grain.

4. In general, the protein content increases with greater relative degree of hardness, and is less variable in the Hard and Dark Hard groups than in the other groups of less vitreous texture.

Texture vs Weight per Thousand Kernels

In Table No. 3 texture has been contrasted with the weight per thousand kernels of the origiral sample. It would appear that the two extreme groups, ie., "Dark Hard" and "Starchy"—both of which groups were below the average of the original sample in weight per thousand kernels—were abnormal.

The "Dark Hard" kernels could very well have been immature kernels, but only a further and more detailed study can explain the lower average kernel weight of the "Starchy" kernels.

Conclusion

1. There is no well defined progressive relation between relative texture and average weight per thousand kernels in the samples studied.

TABLE No. 3. Weight per thousand kernels vs Relative Texture.

Sample	Relative Degree of Texture						Av. Wt. per M. Kernels in Original sample
	Dark Hard	Hard	Spotted	Mottled	Yellow	Starchy	
A	27.83	26.94	27.00	28.86	27.56	40.00	27.80
B	28.39	28.92	30.34	30.38	31.89	30.00	29.60
C	29.45	30.37	32.00	30.36	29.93	29.44	30.07
D	25.27	26.71	25.64	26.43	29.28	19.23	25.59
E	29.93	33.00	30.00	29.40	29.68	30.00	30.30
F	23.33	27.80	28.27	29.25	30.23	27.50	28.29
G	36.31	33.67	30.42	27.91	29.06	30.95	32.81
H	23.59	30.00	28.60	27.20	29.15	29.90	28.38
I	24.62	28.70	26.17	27.50	29.26	25.23	26.20
J	22.69	28.44	27.32	26.56	26.47	21.55	25.73
K	29.84	32.22	28.16	28.16	31.87	28.60	30.02
L	25.92	28.15	28.97	29.31	27.63	27.62	27.50
Total Addition	327.17	354.92	342.89	342.12	26.47 352.01	21.55 340.02	25.73 342.28
Average	27.25	29.57	28.57	28.51	29.33	28.33	28.50

Protein Content vs Weight per Thousand Kernels

The relation of protein content to weight per thousand kernels can be studied in a number of ways. One of these is given in Table No. 4, where protein content and weight per thousand kernels, both on basis of original samples, are compared—the samples being arranged progressively according to weight per thousand kernels.

In general, the samples of lowest kernel weight (weight per thousand kernels) contained the most protein. Samples of average, intermediate and heavy kernel weight (weight per thousand kernels) contained practically the same per cent of protein.

In Table No. 5, the "portions" have been progressively arranged according to increasing kernel weight (weight per thousand kernels) and the protein content has also been tabulated for each of the respective "portions."

Table No. 5 has been divided into two equal parts. The first half, which includes 36 separates, includes those of kernel weight not exceeding 28.86 grams per thousand kernels. The average kernel weight was 26.32 grams per thousand kernels, and the average protein content was 11.77 content was 11.12 per cent. Ten separates contained more protein than per cent. Fifteen separates included in the lightest 36, contained more protein than the corresponding original samples, and twenty contained more protein than the average of all original samples. Twenty-one out of 36 separates were lighter in kernel weight (weight per thousand kernels) than the corresponding original sample.

TABLE No. 4. Protein Content vs Weight per Thousand Kernels.

Sample	D	J	I	L	A	F	
Wt. per M.	25.59	25.73	26.20	27.50	27.80	28.29	
Protein	12.07	12.81	13.21	11.01	12.02	10.73	
Sample	H	B	K	C	E	G	Average
Wt. per M.	28.38	29.60	30.02	30.07	30.30	32.81	28.50
Protein	10.40	11.36	11.81	11.49	11.73	11.88	11.71

The second half of Table No. 5 included 36 separates having a kernel weight exceeding 28.86 grams per thousand kernels. The average kernel weight was 30.94 grams per thousand kernels and the average protein the corresponding original samples, and the same number contained more protein than the average of all original samples. Twenty-two separates were heavier in kernel weight (weight per thousand kernels) than the corresponding original samples.

From the data presented in Table No. 5, one must conclude that low average kernel weight is associated with a higher average protein content.

An interesting question might be raised as to whether the low average kernel weight, or the texture of certain separates had been responsible for the higher relative protein content, if the comparisons had only been made as given in Table No. 5. However, the discussion which accompanied Table No. 1, showed very conclusively that relative texture was an important consideration.

Texture is probably the most apparent indication of high or low protein content, but there is evidence in Table No. 5 to show that when low average kernel weight is associated with dark hard and vitreous texture, the protein content is relatively high. Another comparison is possible from Table No. 5 and may be summarized briefly as follows: Out of 15 separates from the 36 listed in the first half of Table No. 5, all of which showed a higher average kernel weight than did the original samples, nine

TABLE NO. 5—Wt. per Thousand Kernels vs Protein Content vs Texture.
Separates of samples arranged according to progressively increasing weight per thousand kernels.

Portion		Wt. per M.	Wt. per M. vs original sample Plus or minus	Protein Content	Protein content vs original sample. Plus or minus	Protein content vs Av. of all original smpls. Plus or minus
Sample	Separate					
D	6	19.23	–6.36	10.92	–1.15	–0.79
J	6	21.55	–4.18	12.32	–0.49	0.61
J	1	22.69	–3.04	13.12	0.31	1.41
F	1	23.33	–4.96	11.81	1.08	0.10
H	1	23.59	–4.79	12.27	1.87	0.56
I	1	24.62	–1.58	13.76	0:55	2.05
I	6	25.23	–0.97	13.01	–0.20	1.30
D	1	25.27	–0.32	12.40	0.33	0.69
D	3	25.64	0.05	11.00	–1.07	–0.71
L	1	25.92	–1.58	11.84	0.93	0.13
I	3	26.17	–0.03	12.82	–0.39	1.11
D	4	26.43	0.84	11.00	–0.81	–0.71
J	5	26.47	0.74	12.24	–0.57	0.53
J	4	26.56	0.83	12.59	–0.22	0.88
D	2	26.71	1.12	12.29	0.22	0.58
A	2	26.94	–0.86	12.28	0.26	0.57
A	3	27.00	–0.80	11.48	–0.54	–0.23
H	4	27.20	–1.18	10.17	–0.23	–1.54
J	3	27.32	1.59	12.85	0.04	1.14
I	4	27.50	1.30	11.58	–1.63	–0.13
F	6	27.50	–0.79	9.87	–0.86	–1.84
A	5	27.56	–0.24	10.89	–1.13	–0.82
L	6	27.62	0.12	10.34	–0.67	–1.37
L	5	27.63	0.13	10.05	–0.96	–1.66
F	2	27.80	–0.49	11.51	0.79	–0.19
A	1	27.83	0.03	12.56	0.54	0.85
G	4	27.91	–4.90	11.29	–0.59	–0.42
L	2	28.15	0.65	11.84	0.83	0.13
K	3	28.16	–1.86	12.27	0.46	0.56
F	3	28.27	–0.02	10.65	–0.08	–1.06
B	1	28.39	–1.21	12.48	1.12	0.77
J	2	28.44	2.71	12.94	0.13	1.23
H	3	28.60	0.22	10.36	–0.04	–1.35
K	6	28.60	–1.42	11.11	–0.70	–0.60
I	2	28.70	2.50	13.12	–0.09	1.41
A	4	28.86	1.06	10.66	–1.36	–1.05
Total 36	I 8 II 6 III 7 IV 6 V 9 VI 6	947.39		423.70		
Average		26.32		11.77		
Pluses			15		15	20
Minuses			21		21	16

TABLE NO. 5 Continued—Second Half.

Portion		Wt. per M	Wt. per M. vs. original sample. Plus or Minus	Protein Content	Protein content vs original sample. Plus or minus	Protein content vs Av. of all original smpls. Plus or minus
Sample	Group					
B	2	28.92	–0.68	12.51	1.15	0.80
K	4	28.96	–1.06	11.64	–0.17	–0.07
L	3	28.97	1.47	11.01	0.00	–0.70
G	5	29.06	–3.75	10.82	–1.06	–0.89
H	5	29.15	0.77	10.01	–0.39	–1.70
F	4	29.25	0.96	10.50	–0.33	–1.31
I	5	29.26	3.06	12.68	–0.53	0.97
D	5	29.28	3.69	11.48	–0.59	–0.23
L	4	29.31	1.81	10.12	0.89	–1.59
E	4	29.40	–0.90	10.07	–1.66	–1.64
C	6	29.44	–0.63	9.59	–1.90	–2.12
C	1	29.45	–0.62	12.96	1.47	1.25
E	5	29.68	–0.62	10.36	–1.37	–0.35
K	1	29.84	–0.18	12.32	0.51	0.61
H	6	29.90	1.52	9.92	–0.48	–1.79
C	5	29.93	–0.14	10.64	–0.85	–1.07
E	1	29.93	–0.37	12.64	0.91	0.93
H	2	30.00	1.62	broke**	broke**	broke**
B	6	30.00	0.40	9.67	–1.69	–2.04
E	3	30.00	–0.30	broke**	broke**	broke**
E	6	30.00	–0.30	broke**	broke**	broke**
F	5	30.23	1.94	10.03	–0.70	–1.68
B	3	30.34	0.74	10.57	–0.79	–1.14
C	4	30.36	0.29	10.68	–0.81	–1.03
C	2	30.37	0.30	11.96	0.47	0.25
B	4	30.38	0.78	10.44	–0.92	1.27
G	3	30.42	–2.39	11.35	–0.53	–0.36
G	6	30.95	–1.86	10.83	–1.05	–0.88
K	5	31.87	1.85	11.64	–0.17	–0.07
B	5	31.89	2.29	10.11	–1.25	–1.60
C	3	32.00	2.00	12.00	0.51	0.29
K	2	32.22	2.20	12.03	0.21	0.32
E	2	33.00	2.70	12.09	0.36	0.38
G	2	33.67	0.86	11.37	–0.51	–0.34
G	1	36.31	3.50	12.72	0.84	1.01
A	6	40.00	12.20	10.44	–1.58	–1.27
Total 36	I 4 II 6 III 5 IV 6 V 3 VI 6	1113.74		367.10**		
Average		30.94		11.12**		
Pluses			22		10**	10**
Minuses			14		23**	23**

**NOTE: Three flasks broke while the determination of protein content was being made.

TABLE NO. 5 SUMMARIZED.

	No. of Portions	Separates	Kernels Av. Wt. per M.	Wt. per M. vs. Orig. Sample.		Average Protein Content.	Protein Content vs. Original Sample.		Protein Content vs. Average of all Separates.	
1st half	36	I 8, II 6, III 7, IV 6, V 3, VI 6	26.32	15	21	11.77	-|- 15	— 21	-|- 20	— 16
2nd half	36	I 4, II 6, III 5, IV 6, V 9, VI 6	30.94	22	14	11.12	10*	23*	10*	23*

*Note: Three flasks broks while the determination of protein content was being made.

contained less protein than the corresponding original samples. On a similar basis, 15 separates listed in the second half of Table No. 5, and which contained less protein than the corresponding original samples, showed a higher average kernel weight than the original samples.

Conclusions

1. Low average kernel weight is often associated with relatively high protein content.

2. High average kernel weight is often associated with relatively low protein content.

3. When low average kernel weight is associated with hard texture, the protein content is relatively high.

The Sherman Grain and Cotton Exchange, Sherman, Texas.

Some Observations on the Seasonal and Sectional Changes in Kansas Wheat

Roy V. McVey

We can easily answer the question "What is dark hard wheat"? but it is not so easy to answer the question "Why is dark hard wheat dark?"

The purpose of this paper is to point out some immediate examples of seasonal and sectional changes in certain varieties of wheat and to show that in the production of strong wheat a given variety of wheat so far as seeding purposes are concerned means not nearly so much as the conditions under which this wheat is to be grown and the conditions of harvesting.

A large amount of literature has been disseminated among the wheat growers concerning the characteristics of the many varieties of wheat but much less information is at large regarding the agencies which affect these types of wheat. The world is looking more and more to Kansas for a large proportion of strong milling wheat and the prosperity of the Kansas farmers, as well as the commercial life of the milling and grain interests, depends upon the maintenance of the quality of this wheat which means to a large extent the elimination of yellow berry.

With this in mind the writer feels that the opportunity is at hand for us as Chemists to contribute to the technical information needed in the present campaign of the Wheat Improvement Association which has just been formed. It seems that we should be especially interested when we have to worry about keeping our milling mixture up to a proper strength when our companies have to pay as high as 30c for high gluten wheat over ordinary wheat of the same grade.

It is common knowledge that seasonal and sectional changes do occur and for that reason it is not necessary to make a tabulation of all of our results; however, we will point out the following observations in order to serve as a basis for our analysis of the subject.

The following examples of sectional changes were noted: Some years ago several cars of dark turkey wheat from Western Kansas were distributed in the locality of one of our country elevators where only soft wheat was being produced. In the resulting crop not a bushel of strong wheat was found. The same strain of wheat is continuing to be grown in that locality and is varying from 9% to 12% in protein varying with the elevation and water supply.

Kanred wheat was introduced in the locality of another one of our country elevators. In most instances the resulting wheat went from 10% to 10.50% protein. However, in one instance the Kanred wheat gave a crop of 12% protein wheat, this being only a short distance from where the 10% wheat was raised but a part of the field was on a knoll. The 12% wheat was a mixture of 30% dark grains and 70% of yellow grains, the dark part originating from the higher ground. Another sample of Kanred grown at one of our Western stations went 11.25% protein when the average of the receipts of other wheat from that station went 13.50% in protein. The Kanred wheat showed a greater tendency to turn yellow than the other varieties. In one locality where soft wheat prevailed samples of soft wheat were obtained of wheat produced in this locality from hard wheat which went from 10% to 10.50% protein. The variation in strength varying more according to the elevation than to the variety.

The topography of the fields could almost be ascertained in many of the samples which we examined from the number of dark grains mixed in with the yellow grains. From one station which had been sending in almost pure soft wheat averaging about 9% protein we obtained a sample grown from soft wheat seed which sample contained 20% of pure dark hard grains which when picked out went 13.25% protein, the remaining portion going 10% in protein. Upon investigation we found that a part of this field was situated upon a hill.

All of the samples which we obtained of Black Hull wheat ran from 10% to 10.50% in protein. Black Hull wheat is low in resistance power, and although of a hard variety of wheat, is better adapted to easy growing conditions which are not conducive to high protein content.

The seasonal changes were practically as marked as the sectional changes except that most of the data had to be gathered from past records. These records showed that from year to year the variation in strength in some localities were very great while at others the wheat remained quite constant in strength.

The wheat from five of our country elevators averaged less than 11%

protein while in most of the preceding years these localities have produced very strong wheat. In one instance samples were obtained of wheat which was grown on the same ground from the same seed for the past two years, the 1920 sample going 12.20% protein while the 1921 sample went 10.35% protein. Then with the evidence of the changes in the quality of the various varieties in mind we tried to find some of the causes and to see if some of these causes could be controlled.

The starch and the protein being the components of the wheat grain which determine the strength we can first consider the conditions favorable for their formation. The starch, being composed of carbon, Hydrogen and Oxygen, gets its carbon from the carbon dioxide of the air and its Hydrogen and Oxygen mostly from the water of the cell sap. The protein is formed from a combination of some of the carbohydrates with the salts from the soil. The larger proportion of the starch and protein are used in the construction of the cell wall and protoplasm and the part stored is merely an excess which is not needed in growth. Then considering the wheat grain as a storage place for the excess nutrition which would otherwise be used to feed the offspring but for our purpose furnishes the endosperm of the wheat, it would be reasonable to expect that anything that decreased the amount of excess starch or increased the amount of excess protein would benefit the starch-protein ratio.

The Nitrogen in the protein must come from the nitrates of the soil but it is conceded by those who have made extensive experiments that the condition of the soil plays a very small part in the strength of wheat. One experiment station even removed soil from a soft wheat locality to a hard wheat locality and transplanted the hard wheat locality soil to the soft wheat district but the resulting crop from each district remained the same.

The water supply is the most important factor which affects the protein content. The variation in strength with the elevation seems to be due more to the water supply than to the condition of the soil. Since the water is directly used in the formation of the starch, the relation between the size of the grains and the protein content was studied with the idea in view that possibly the amount of protein which was stored in the individual grains remained fairly constant but that the amount of starch varied causing the change in the starch protein ratio.

To obtain this relationship the protein content was run on a large number of samples varying from 9% to 14% in protein. Then one hundred grains were counted from each in a uniform way discarding only the broken ones. The results showed that there was a fairly definite relationship, the weight of 100 grains being inversely proportional to the protein in the original sample. It was necessary to convert to the same test weight basis however as in some of the low test weight samples the ratio of bran to endosperm would affect the results. Some irregularities were found, however, but the results convinced us that the variation in production of starch was the main cause of the variation in the wheat but that some other things did enter in when the wheat was grown under widely varying conditions.

We believe that this helps to explain why the dryer growing conditions tend toward higher protein wheat. It seems quite reasonable to believe that a decreased amount of water and strenuous growing conditions tend to

prevent an excess formation of starch while the protein would not be affected.

In order to understand this we must take note of how starch is formed. In the process of carbon-fixation the chloroplasts bring about a combination between the carbon dioxide from the air and water from the cell-sap forming formaldehyde which is polymerized to a carbohydrate. However, a counter process which we call respiration is going on in the growing plant, which breaks these carbohydrates down with the taking on of oxygen and giving off of carbon dioxide.

However, when the growing conditions are most favorable, the growth rank and the chloroplasts abundant the production of starch is so much greater than the destruction that an excess is formed. This excess of starch is converted to soluble sugars by the enzyme invertase and carried osmotically to the grains where the lencoplasts convert it back to starch.

The early ripening grain and that which was not allowed to become too ripe when harvested showed a higher percentage of protein. This is also due perhaps to the fact that an excess formation of starch is impeded. As although the growth is finished some of the chloroplasts would remain active and carbohydrates would continue to be formed until the grain was dead ripe.

Then we might consider for a moment what efforts might be put forth which would help to keep the strength of our wheat crop at a maximum and tend to eliminate the yellow berry tendencies.

In the past the farmer has not given any attention to the strength of his wheat. He has received practically the same price for the weak wheat as the strong. Although the high gluten wheat is now bringing from 25 to 30c more than weaker wheat of the same grade in the terminal markets the producer of strong wheat is not rewarded in this manner. For this reason he has had no cause to strive to keep the quality of his wheat up in this respect. The State Board of Agriculture has made extensive surveys intended to increase the yield and protect the soundness but there is nothing in their quarterly report which would encourage the farmer to eliminate the yellow berry from his wheat. Much work has been done at the Experiment Stations to develop certain strains yhich would yield well and were originally strong enough. We are convinced that the yellow berry is due almost entirely to conditions rather than hereditary tendencies. We believe that some efforts should be directed toward educating the farmer as to how to maintain the strength in his wheat. As long as he is paid a common price for his wheat he will give little thought to anything other than yield and test weight while if he was paid according to the milling value of his wheat he would have an incentive to study the conditions of his farm, the water supply and the best method of harvesting with the intention of eliminating the yellow berry. It might be argued that every wagon load of wheat could not be tested for strength. This is true but it is also not necessary. Any wheat buyer ought to be able to tell the difference in strong and weak wheats not only by the external appearance but by the white, starchy cross section of the yellow berry as compared to the translucent or semi-glassy cross section of the dark hard. Standards of classification could certainly be worked out for this.

It is true that the Southeastern part of Kansas is not adapted to

raising dark hard wheat and that the Southwestern part is only adapted to hard wheat but there is a wide area on the dividing line between these two districts, part of which will produce strong wheat and part will not, varying almost entirely with the elevation and water supply . However, in these parts such varieties as Kanred, Black Hull and Turkey wheat predominate with the result that Kansas hard wheat is promiscuously adulterated with yellow berry which undermines its milling value. The result is that the miller must deal with a large amount of yellow berry in order to use the dark wheat which is adulterated by the yellow grains. This adulteration could be checked from the beginning of the movement of the crop if a proper premium was paid directly to the farmer for the unadulterated dark wheat or, in other words, if he had to receive a discount for allowing it to become mixed.

Arkansas City Milling Co., Arkansas City, Kansas.

Infestation of Cereal Products by Insects and Methods of Control

By J. C. Wood

In writing this paper dealing with insects of cereals my purpose is to impress upon the Cereal Manufacturers the importance of keeping his plant and warehouses free from insects. Not only to stop his own losses but to do his part in controlling insect infestation in general. The amount of foodstuffs destroyed each year by insects is enormous and the cost to mill interests runs well into the millions. Prof. George Dean has stated that the loss to Kansas Grain and Mill interests may be placed very reasonably at not less than two million dollars annually. It is evident from this figure that the loss sustained throughout the country is enormous and far beyond any conception we may have entertained.

It would seem that the Millers who keep a dirty mill which is favorable for infestation and does not take proper measures to combat insects is guilty of aiding dissemination of his pests, and thereby the destruction of foodstuffs.

Fortunately the losses incurred and the fact that the presence of insects in grain causes it to be graded sample grade, which detracts from its value, has caused those concerned to take an active hand in combating insects. This fact, along with our modern construction of mills and warehouses, has done much to make a change for the better. However, the past few years have been so favorable for the increase of insects that we find ourselves harvesting a wheat crop while our friends the moth and weevil are waiting to make their usual ravages upon it.

We, in the milling business, by proper construction of building, cleanliness, and preventative measures and by refusing to accept shipments infested with insects can do much towards remedying these conditions.

More than seventy specie of insects, injurious to grain and grain products, are known in the United States, and the great majority of these have been introduced by commerce. About twenty of the most serious of

these insects are well distributed over the United States. The species are small, the largest beetles being about five-eighths inches in length while the majority are less than one-fourth inches long. They vary in color from a reddish brown to black. The moths are also very small, the work of their larvae can be distinguished from the larvae of the beetle by their webbing habit, with the one exception of the Angoumois Grain Moth.

The major pests are the Granary Weevil, Rice or Black Weevil, lesser Grain Borer, or Australian Wheat Weevil, and the Angoumois Grain Moth. The above are the most destructive to grain. The Mediterranean Flour Moth causes much damage in mills owing to its webbing habits. The Confused Flour Beetle and the Cadelle are the major flour pests, while the Indian Meal Moth, the Meal Snout Moth, and the Saw-Tooth Grain Weevil are the most prevalent in meal, breakfast foods, etc.

These insects have spread rapidly over the United States and today few cereal plants are free from infestation. Insects are distributed by commerce; a badly infested plant shipping out infested products is almost sure to infest every plant, warehouse, or building that the products may be stored in. The infestation of cereal plants can be traced to the use of second-hand and returned bags more than any other cause. The use of returned or second-hand bags should be discontinued or measures taken to destroy insect life before taking them into the plant.

Some plants are equipped with a suction apparatus with a tube about the size of an ordinary bag. The strong suction turns the bag inside out, pulling the bottom of the bag up in the tube. The air filtering through carries away the dust and any live insects but the eggs adhering to the bag are not removed. At time of depositing the eggs the insect secretes a fluid which cements them to the object on which they are deposited.

The refuse from the suction pipe is collected in a dust collector and in the case of cottonseed meal, linseed meal, and other expensive concentrates the refuse is valuable, provided it is treated to kill insects and any eggs that may have come over. The amount of meal saved will more than pay for the installation and operation of the device.

Second-hand bags should never be taken into the plant but to a tightly constructed building and treated either with heat or by fumigation. An effective and rapid method of heating is to construct a large reel in the heat house, the surface being of slats or perforated metal. The bags are placed in this reel, the rotary motion exposing all parts of the bag to the heat. A coil of steam pipes beneath the reel will heat it much above the killing temperature. Thus in a short time all insect life is destroyed as well as the eggs.

The installation of second-hand machinery is another method of introducing insects. An old mill machine is almost invariably infested and should be cleaned and thoroughly sprayed throughout with a good insecticide before taken into the mill.

The manufacturer who buys flour for blending and those engaged in the mixed food business must constantly be on the alert for insects. Not only is he bringing in sacked products from over a wide area, but is compelled to keep his warehouse well stocked, thus making an ideal place for insect development. When he receives a car of infested goods it must be rejected or freed from insects before storing in his warehouse.

If a plant is located in the center of general infestation it is impossible to keep out moths as they fly from building to building.

Control of Insects

The first precautionary measure in controlling insects is cleanliness. Accumulation should not be allowed to collect on ledges, in cracks, corners, etc. Walls should be swept down and in case of old frame structures a coat of whitewash is of value. This may be applied with a spray, the cracks are filled making them impervious to insects. Elevator legs may be kept clean and free of webbing by a brush described by Chittendon. A piece of one and one-half inch wood, the width of elevator cup, is fitted with stiff bristles on three sides and bolted to the belt. One brush of this kind on each elevator will keep the leg clean and free of infestation. Basements should be kept clean and light as possible. A liberal quantity of lime placed in corners and along the walls prevents insect development and has a tendency of purifying the air. Too much could not be said on cleanliness as every pile of dirt in corner, crack, or elsewhere is an open invitation for the breeding of insects.

Many methods of control have been advocated from time to time, such as fumigation with tobacco fumes, sulphur, formaldehyde gas, Carbon Disulphide, etc. Much experimental work and investigation has proven heat and hydrocyanic acid, fumigation, and spraying with a proper insecticide to be of the greatest value. When the conditions are favorable heat is the cheapest and most effective method of control now known.

Control by Low Temperature

In the far north where temperatures reach 20 to 30 degrees below zero. doors and windows can be thrown open for several nights in succession and good results are sometimes obtained. However, insects are quite resistant to low temperatures and when they are imbedded in flour or feed can withstand temperatures below zero. Further South very little good is accomplished by this procedure.

Control by Heat

Heat is recognized as the most effective and inexpensive method known and is absolutely safe. Only in buildings that are so loosely constructed that a temperature of 118 to 125 degrees F cannot be maintained is heating impractical. Buildings piped with steam for heating in winter usually have enough radiation to heat the building above 125 degrees F when the temperature outside is above 80 degrees. Even though additional radiation is required or where a heating system is absent the cost of steam piping necessary will pay for itself in a very short time by the savings due to cheapness of the heat methods. Owing to construction of buildings the amount of radiation needed will vary greatly. A good engineer will be able to compute the approximate radiation and more can be added if found necessary. The best time to apply heat treatment is in the summer when the outside temperature is above 80 degrees, and on a calm day. This will obviously mean a saving in fuel.

The building should be made as tight as possible, all cracks stopped up and any inside doors closed to prevent drafts. Accumulations of flour in and about machines should be cleaned up. All machines should be open and spouts and elevator caps removed. Heating should be started imme-

diately after a shut down to take advantage of the heat in the machines. The temperature should be maintained from 118 to 125 degrees F throughout the building for period of several hours. Unless radiation is well distributed parts will necessarily have to be heated much higher. In heating the warehouse where feeds are stored the stocks should either be disposed of or spread out in such a manner that as much of the bag as possible is exposed to the air. This can be best accomplished by setting the bags on end in rows, leaving an air space between each bag. A temperature of 140 to 150 degrees should be maintained for twenty-four to thirty-six hours in order for the heat to penetrate the contents of the bags.

When a kiln-dryer is maintained for the drying of corn; bags may be placed on the dryer where a higher temperature may be had at a small expense. At a temperature of 150 degrees 24 hours time was found necessary to bring the contents of the bags up to a killing temperature.

Control by Hydrocyanic Acid Fumigation

Hydrocyanic Acid Fumigation has been in use for a number of years and is generally understood, so will not discuss the manipulation of the procedure here.

The Hydrocyanic treatment is effective in mills especially with the Mediterranean Flour Moth, but its value is limited in warehouses where feed stocks are stored, as it will not penetrate much more than an inch even in products that are comparatively loose and bulky. Fumigation should be carried on when the temperature of the building is above 70 degrees as below this temperature the insects are less active and thereby less susceptible to the gas. If the building is infested with weevil, Hydrocyanic Acid Fumigation is of little value as most of the beetles do not succumb to it. In preparing the building for Hydrocyanic treatment great care must be exercised in making it as near air tight as possible, and care must be taken to remove all accumulations in and around the machines. All ledges, cracks, etc., should be thoroughly cleaned as the gas will not penetrate to any depth and every pile of dirt or flour affords shelter for the insects.

Control by Insecticide

Insecticides have not been used to any great extent in mills, owing to objectionable odors left in the flour and to the toxic effects most insecticides would have should they come in contact with the flour.

We now have insecticides composed of oils and hydro-carbons which will destroy all insect life as well as the eggs. This kind of an insecticide will not leave an objectionable odor or in any way harm the belts or machinery, and as it is all volatile it will not poison any products it might come in contact with.

The application is made with an air pump spray, equipped with a hose and nozzle. As in fumigation the building should be made as clean as possible before spraying in order not to afford any place for shelter. The building should be sprayed thoroughly, getting into cracks and corners. Machines should be sprayed inside and out. Two thorough applications will usually prove effective.

Insecticides can be used more effectively in warehouses and plants where there isn't the complicated machines to contend with, also spouts and elevator legs.

The writer would not advocate the use of insecticides in a badly infested Mill if heat treatment or Hydrocyanic Acid Fumigation is practicable. An occasional spraying as a precautionary measure to keep down infestation is invaluable.

Stored Grain Fumigation

Much of the grain on the market is infested with insects, many of them being on the inside of the kernel and cannot be removed by cleaning machinery. Carbon-Disulphide Fumigation is the most effective method known, but on account of its inflammable and explosive nature Insurance Companies will not permit it to be used in an elevator. However, it can be used to good advantage in a car of grain. The vapor being 2.63 heavier than air it will work down through the grain and kill all insects. The quantity used depends upon how tight the car or bin can be made. One pound is usually used for every 25 bushels. In treating a car the disulphid can be poured on the wheat in several places or placed in shallow pans and allowed to vaporize. After the liquid is placed the car should be sealed tightly and allowed to stand for several hours so the gas will have time to penetrate all parts of the grain. A tarpaulin or canvas spread over the surface of the grain will facilitate the holding of the gas. Fumigation should be carried on during the heat of the day as higher temperatures makes the treatment more effective. Professor Dean states that below 60 degrees F, the amount of disulphid required and the results obtained are so unsatisfactory that it is impractical to attempt fumigation.

Carbon Disulphid is inflammable and explosive but it may be used with safety if proper precaution is employed. The gas ignites at 297 degrees F, so no smoking or lights of any kind should be brought around where the vapor is strong. Electric switches should not be used and even a hot steam pipe might ignite the gas. Carbon Disulphid should not be used in heating grain.

Carbon Disulphid gas is highly poisonous but its toxicity is not such that it cannot be used with safety if caution is employed. It produces giddiness, vomiting, congestion, coma, and finally death. However, the worker may inhale the fumes for some time without experiencing any ill effects. The disagreeable odor is noticed at first but later cannot be detected, showing the dullness of the sense of smell. The other senses are likewise benumbed and the operator will not realize that he is being affected. The heart action is more rapid owing to a scarcity of oxygen. Hearing and sight are both weakened. Before these symptoms become pronounced the operator will feel giddy or dizzy and he should at once get some fresh air where the ill effects will soon pass away. A person suffering with a weak or diseased heart should not take chances working with disulphid.

The writer has experienced with carbon tetrachloride as a substitute for Carbon Disulphid, as Carbon Tetrachloride is not explosive and can be used in elevators. Rather more of the Carbon Tetrachloride was required but good results were obtained at a cost of about 1c per bushel, which is cheap compared with difference in value of grain before and after fumigation.

Owing to the fact that Carbon Tetrachloride does not penetrate as rapidly as Carbon Disulphid the following procedure was employed. A

bin of infested grain was transferred to another bin. After about four feet of grain had run in a dose of Carbon Tetrachloride was applied. A pound being used to every 15 to 20 bushels. This procedure was carried out until the bin was full—ie., a dose being applied every four feet. After a few days the grain was loaded out and no live insects could be found. When this method was employed the results were good, but when used on top of grain it did not penetrate thoroughly. Experiments were carried out in metal containers filled with infested grain. The Carbon Tetrachloride was introduced on top and the container covered. A period of nearly two hours was required to kill the beetles at a depth of two feet, and a much longer time for three feet. The Carbon Tetrachloride was used is same quantities as in the elevator. Carbon Disulphid under the same conditions diffused much more readily.

This work was done in cold weather and no doubt it would have been more economical if carried on in hot weather.

Carbon Tetrachloride has the advantage of being non-inflammable and may be used with absolute safety at any time. It may also be used in heating grain to even better advantage as the heat helps to volatilize the liquid. Carbon Tetrachloride is more expensive than Carbon Disulphid and more of it is required. Its use could only be recommended where Carbon Disulphid is prohibited.

Conclusion

Control of insects in flour and cereal mills has become a matter of vital importance both from a standpoint of economy in manufacture and the destruction of foodstuffs.

Modern Construction of buildings with better methods of control make it possible to reduce infestations to a minimum. The farmer through the medium of County Agents and publications are being instructed how to handle grain to prevent infestation. All of which points towards better conditions.

Each manufacturer of cereal products should keep his plant free from insects even though his conditions are such that the insects cannot become a menace to him, for if he harbors insects he will distribute them and his customers who keep a stocked warehouse will suffer.

If each manufacturer performs his duty, or putting it in the vernacular does his bit, conditions will be improved, millions of dollars saved to the milling trade, and an infinite amount of foodstuffs preserved.

Scott County Milling Co., Sikeston, Mo.

Of How Much Value is the Protein Test

LESLIE R. OLSON

We hear so much nowadays about guaranteed protein content of wheat for milling, and guaranteed protein content of flour for baking purposes. Many grain companies sell wheat mainly on a protein basis. By testing numerous samples secured from various sections early in the season, and later testing all incoming cars, they are enabled to classify their purchases on protein content, and offer wheat to the miller accordingly. Many flour

buyers, in turn, specify a definite protein content, and unless the miller is in a position to meet this particular requirement he has no chance to get the order.

Let us consider for a moment just what protein is. Protein is a term used to designate the entire group of nitrogenous compounds of food except nitrogenous fats. The proteins are the most important constituents of the wheat kernel. Upon their nature depends the baking value of a flour. There are five distinct proteins present in wheat flour, namely:

1. Gluten proteins,
   (a) Gliadin,
   (b) Glutenin,
2. Non-gluten proteins,
   (a) An albumen—Leucosin,
   (b) A globulin—Edestin,
   (c) Proteose.

These can be determined as a whole, or separated and determined separately. The term gluten is applied to the two definite proteins. Gliadin and Glutenin. The crude gluten as obtained by washing the dough contains in addition small quantities of starch, cellulose, and mineral matter. Protein is a definite compound and is determined by an exact chemical method, while gluten is an impure mixture determined by physical means. Yet there is no way of arriving at the quality of the protein other than washing the gluten or conducting a baking test.

There has been in the past a good deal of discussion on protein versus gluten, and as a result the former has supplanted the latter test in a great many laboratories. As to whether or not this is a step in the right direction we will reserve our opinion for a few minutes. The fact remains that the protein test has sufficient value to be included in daily control work, which is done primarily to assist in keeping the flour uniform in quality. To make a uniform flour from day to day is the biggest problem of any miller, and his ability to do so largely determines the success of the company. The baker insists upon a uniform flour. If he does not get loaf volume, bright color, proper texture, and good flavor from each shipment (or even each baking) the responsibility is hurled back to the mill.

After the flour is once manufactured it cannot be changed, and the only logical control is in the wheat. Wheat for flour milling has positive values. But varieties, grades, and condition of the wheat vary so widely that the miller is always confronted with changing flour quality. And so the milling chemist in his efforts to maintain uniformity in the flour instituted the protein test as a basis for wheat selection. It is then possible to blend the wheat to give a definite protein content in the milling mixture. Upon the miller demanding wheat of a known protein content it is only natural that the grain dealer arrange to supply his needs. And so the buying, binning, and blending of wheat on a protein basis has been developed, and is now used by a large number o mills.

Is the protein test in itself an absolute method of obtaining the true value of wheat? No, for protein is not the only constituent in which wheats vary. On using the protein system does the resulting flour run any more uniform? It does in quantity of protein, but not by any means in the quality of same. There is one exception to the last statement, and

that is the small miller located in the heart of a good wheat section, who can secure sufficient wheat of one variety, known to be of good quality, to run him through the year. An interior Kansas mill, or western Canada mill will serve as an illustration. One is situated in the Dark Turkey Hard Winter belt, and the other in the Marquis Hard Spring territory. Under usual crop conditions a small mill in either locality has no wheat selection problem. The good wheat is there for them to grind and the protein basis will keep the flour uniform.

Let us consider how the system works out for the large miller in the city away from the wheat fields. The wheat buyer purchases according to government grades, taking into consideration the physical appearance of the wheat and information as to its weight, etc., given by the government inspector. He is furnished by the mill laboratory with a record of the protein content of all cars unloaded to assist him in making further purchases. The large capacity of the mill or mills for which he buys requires a vast amount of wheat. The supply of good wheat is becoming more limited each year with the result that the buyer is compelled to draw from a wide spread territory. His judgment will insure wheat of sound physical appearance, but he may be misled as to its milling value and the quality of flour it will produce. We all know that different kinds of wheat give different qualities of flour. Therefore, when you begin to blend wheats you have a big problem. Maintaining a definite protein content in your blended mill mix is just one step toward insuring uniform flour quality. The large miller relying solely on protein to solve the problem will be disappointed. The system can be made more reliable by taking into consideration the kind of wheat and its moisture along with the protein content. This requires a series of many storage bins and as most mills do not have these facilities it becomes impracticable.

What governs the amount and character of the protein present in wheat? Soil and climate, the former being the only constant factor. As a result the fact that a certain territory produced wheat high in protein last year does not mean that it will do so this year unless similar climatic conditions prevail. It follows further that last year's records are worthless so far as using them as a guide in making selections this year. A high percentage of protein may be brought about by hot, dry weather at the time the kernel is filling, thereby preventing starch formation. Wheat from long straw is usually low in protein, while a short straw crop tends to run high.

The protein content then is indicative of very little unless accompanied by a statement about the quality of gluten. From the two we can obtain a good idea of the value of a sample of wheat. To get at the gluten quality an experimental mill is absolutely necessary for first making the flour. If you have a man who knows how to do this milling right you can at the same time get information on the yield of flour and feed. It is true that gluten quality is a difficult thing to express in definite terms. Some glutens are much more elastic and rubbery than others, while some are weak and flabby. Furthermore, there is not necessarily a distinct relation between the characteristics of the gluten and the baking qualities of the flour. Yet the gluten report of an experienced operator on a set of samples means a great deal more to many of us (myself included) than the quantity

of protein. Bread is the final test of flour, and if you have time, by all means bake the flour from the experimental mill. One reason some millers can make a flour of quality without a laboratory is because they use the bread test only and have milled to improve each stream so that it bakes better.

What has been said of the unreliability of using the protein test alone on wheat is in a greater measure true of the test when applied to the manufactured flour. One reason why some flours of late years have shown a lack of baking strength and inability to withstand punishment is because chemists have judged the flour milled by the protein test. The more intelligent bakers are no longer clamoring for grades of flour based on protein content. They have learned better. They know that it is easy to overestimate the value of mere quantity percentages of protein, that gluten quality is of more importance. What really counts is the way the flour actually works in the housewife's kitchen or the commercial bakery. The protein content is merely one of the factors effecting the value of a flour and at present we need both the gluten and baking tests in addition to establish its worth. There is no doubt but what some day a single method of laboratory examination will be developed which will enable the milling chemist to make an unerring statement as to the quality of a flour.

International Milling Co., New Prague, Minn.

Relation of the Cereal Chemist to the Baking Industry

By E. B. CLARK

The baking and milling industries are so closely related to, and controlled by, the sciences, especially chemistry that it is fast becoming more and more necessary for the successful leaders of those industries to acquaint themselves, not to any small extent to a large degree, with the application of the science of chemistry to the practices of milling and baking. Upon acquainting themselves with the chemistry involved in the processes of their production, whether they be owners or managers of either bakeries or flour mills, they can control and direct with greater ease and wisdom, the problems of production as well as sales policies, and the economies of manufacture.

This can be and is being done by the successful 'men of affairs' in our two closely allied industries of baking and milling; and with no lesser degree of success does the cereal chemist improve himself by studying and familiarizing himself with the practical details of the processes of baking and milling, whether he be connected with either a baking or milling organization.

Because of the training and experience each cereal chemist in the milling industry has had, he is already familiar with the chemically scientific problems of grain selection, wheat tempering, flour milling and purification, and flour judging, as well as the practical side of milling. Each

cereal chemist of the milling industry to be truly successful should likewise be intimately acquainted with the chemistry of bread baking, the selection of baking materials and possess a practical knowledge of modern bakery operation and bread manufacture.

To devote this paper to a discussion of the methods and principles of bread baking with which each of you are already more or less familiar, would hardly be wise, for after all the operation of the largest bakery in this country is but an enlarged application, in theory and principle, of the baking daily carried out in the laboratories of the flour mills.

You will note that I say, 'in theory and principle'. And as a side issue may I herewith warn those of you who are now, or are desirous of doing later, assisting your mills with the practical problems confronting the baking customers of your organization. You should be warned that while the theory and principle are the same, still the application of theory and principle as understood by you, to the problems of practical bakery operation, will involve hundreds of greater or lesser problems which can be solved only by those who thoroughly understand modern and practical bakeshop operation. It is in this regard that many an honest and conscientious chemist or demonstrator falls down and loses that respect so essential to the proper function of the position he either occupies or hopes to occupy.

Experience without limit is an essential toward a complete understanding of any practical art, be it either milling or baking.

The chemical staff or chemist of each flour mill fills an important place in the business relations existing or to exist between the baking trade and the flour mill, for with tact, judgment, and study they can control the good will of the mill's trade by furnishing its baking customers with satisfactory and uniform flour. If the chemists understand bakery problems as well as milling problems their field of usefulness to their organizations is unlimited.

The problems confronting the cereal chemist of the flour milling industry in making sure that the products made in his mill are satisfactory to the trade, may at first thought seem to be many. But after continued analysis and investigation all problems will, I believe, resolve themselves to only two in number. These two problems form the crux of all baking problems and practically all irregularities or trouble in the baking industry can eventually be traced and either solved or aided by a study or investigation of one or the other, or both. Specifically I have reference in problem one to FLOUR and in problem two, to FERMENTATION.

Problem One *The Flour and Its Study

In the baking industries as in all industries it is sometimes difficult to select any particular element or material used in production and say that thereon stands the entire fabric and structure of the finished product. All elements are of importance else they would not be used; without one the entire system of production is destroyed. This much is true however, each industry is dependent upon one or sometimes two basic materials for its product, and just as wheat is the basic element in the production of flour, so flour bears the same relation to the making of bread.

No element in bread baking is of greater importance, even of as great importance, as the flour, and any milling cereal chemist desirous of as-

sisting his organization with its baking trade must know how to study, not only his own mill's flour but must know how to study all flours, from not alone the viewpoint of the miller but most of all from the point of view of the baker whom he desires to assist.

The satisfaction which bakeries receive from the use of a flour, aside from depending primarily upon the quality of the flour, depends also upon the type of bread baked, the method employed in baking, and the ideas and ideals as to just how a dough made from the flour should perform during the process of production. Because of the human element entering the degree of satisfaction received from a flour, one baker may be entirely dissatisfied with a flour pronounced extremely desirable by another baking organization. One car of flour received may give excellent results, while the next car of the same brand from the same mill, and milled so as to duplicate the former flour may bring forth a violent storm of complaint. Again right in the midst of a crop season producing flour giving uniformly good results everywhere, will spring up a group or number of complaints wholly unwarranted as far as the milling organization can observe. Why does all this seeming contradiction exist? Who is at fault? The primary trouble lies, I believe, in the failure on the part of either the mills or the bakeries or both, to study their flours. Variation in flours will occur naturally at all times; seasons vary, soils have different composition in different fields, storage conditions are not identical, and because of these natural and to some extent uncontrollable sources of varyings, the study of flours becomes more and more important.

As stated before, study will remedy most causes for complaint on the deficient quality of flours. There may be occasional cases where through decomposition and spoilage flours are rendered unfit for bread making but there is no flour unless it be so decomposed which will not produce saleable bread, with varying degrees of quality of course if it is studied, but with no disastrous results so often obtained.

Flours should be thoroughly studied in the flouring mill and tests should cover ash, moisture, color, soundness, and finally its strength or ability to undergo fermentation ascertained. The determination of strength is paramount to all tests, and is most reliably determined I believe by doughing the flour and the physical body of gluten washed from the dough. Careful and exhaustive study of the gluten, its feeling and consistency, its color, and behavior while washing will give more indication as to the actual value and character of a flour than any other test now applied to flours.

To more perfectly give the baking trade what it desires in the way of suitable flour, the mill chemist should study well the character of glutens in the wheats available for his mill and select a blend or 'mix' which he believes from study will give this suitable flour. After ascertaining from his mill superintendent and grain buyer whether or not such a mix can be maintained in an average manner, year in and year out, allowing for the natural variation between crop seasons; the laboratory milled flours should be exhaustively baked before submitting the proposed mix to the superintendent for milling. The desired mix, once milled on a large scale, and flour produced therefrom, the flour so milled should be placed in the hands of a reliable baking organization for exhaustive prac-

tical bakings. When this chain of checking has established the flour to be as nearly satisfactory as possible, the mill should then have in mind a well established general guide or line to which to follow in the future years of its business. Beyond this the mill can do nothing more, other than to offer the bakers all assistance possible in the utilization of its flours.

Upon receipt of all flours the baker should study flours in the same manner but even more exhaustively than the miller for should the flour received be unaviodably un-uniform, the bakeshop now has the power to correct the error and upon learning the character of the flour, the baking processes may be altered so as to use the flour most advantageously.

The same methods should be used by bakeries and mills alike for testing, and should cover ash, moisture, color, dress, granulation, soundness, and other characteristics. Again and most important of all, the baker should carefully test the strength of his flour, determining the amount and quality of the gluten. The study of the gluten should be made so thorough that upon using the exact and best method for handling and fermenting will come to the chemists or baker's mind.

Following the study of flours, the reporting of results is of greatest importance. It is surprising what a large majority of criticisms upon flour quality, be they favorable or unfavorable, come from the desks of purchasing agents or other officials of baking institutions who base their judgments solely upon certain mathematical percentages reported to them by their laboratories. Percentages whether reported singly or in comparison with some standard mean little and have only small value unless they are properly interpreted.

Chemists, whether connected with baking or milling organizations can do much to overcome this difficulty by giving the results of their study of a flour, in addition to reported percentages, by giving a general summary in plain and easily understoood wording, so as to avoid misunderstanding and the ever present tendency toward over-emphasis of numerical figures. Percentages should be interpreted with reservation, they should be weighed, balanced and compared, and any tests or studies reported whether in percentages or wording should be as simple and easily expressed as possible.

The Ideal Flour for the Baker

At this point, though somewhat aside from our discussion it might be well to indicate just what kind of a flour, strength, milling, and tests considered, seems most satisfactory for use in commercial bread baking. The question can not be answered definitely because of the varying ideas and ideals as to just what constitutes the perfect bread.

It might be stated, however, that taking the baking industry as a whole, greatest satisfaction is being obtained from flours of approximately 75 to 85% extraction, of medium granulation, being fairly 'sharp' to touch, and with a light cream or near white color. Such flours correspond generally speaking to those containing approximately .38 to .42% of ash, with a gluten strength of from 10.75 to 12.25%, and with not over 13.25% of moisture.

The popularity of straights or long patents among bakers is diminishing for their desirability was established just after the lifting of Food

Administration regulations calling for substitutes in bread for wheat flour. The popularity was due primarily to the marked difference between the bread made from a straight or long patent wheat flour and the bread made from the use of cereal substitutes. The difference was so pleasing to the consuming public that there was very little if any advantage to be obtained from the use of short patent flours. Competition, however, at the present time is forcing many bakers to gradually use larger amounts of flours of lower extraction or shorter patent.

Problem Two *The Fermentation of Doughs

While the comparison is not the same in all respects when compared to a similar operation in the milling industry, still the fermentation of a bread dough, can well be likened to the tempering of a wheat mix before it goes to the rolls for grinding into flour. During the period of fermentation, presumably by hydrolysis the gluten of a flour undergoes change and breaking down until at the end of fermentation the gluten and dough are in such a condition as to be worked with and handled most advantageously for the making of bread.

The milling chemist desirous of aiding the bakers in their practical problems or who desires to have his mill's products meet the bakers demands, must study the fermentation of doughs in the same manner as the flour was studied. Every condition and ingredient affecting fermentation should be thoroughly understood, this being more important to the milling chemist because of the fact that different flours require different fermentation. The mill chemist should understand just what fermentation to employ and the most advantageous way to produce the desired fermentation.

As in the tempering of wheats, the period of time involved for tempering will decide whether the milling will be satisfactory, so in fermentation of doughs, the period, degree, or length of fermenting or aging is of primary importance.

It is indeed surprising within what narrow limits of time the proper and improper fermentation of a dough takes place. The difference of ten minutes between two doughs containing the same ingredients and of the same temperature will prove one dough to be too young or too little fermented and the other as too old or having had an excess ageing.

The control of time or period of fermentation depends definitely upon three factors, and to some extent upon a fourth factor, first, yeast; second, salt; third, temperature; and fourth, the size of the body of dough to be fermented. Degrees of these factors which increase fermentation and shorten the period of fermentation of doughs are: increased yeast, decreased salt, increased temperature and larger sized doughs. Degrees of these factors which decrease fermentation and increase the time of the ageing period are decreased yeast, increased salt, decreased temperature, and smaller size of doughs.

The balance of yeast, salt, and temperature decides the point or period of fermentation, once the characteristics of the flour and materials used have been ascertained by test and study. The strength of a flour is the ultimate deciding factor for long or short, heavy or light fermentation. The stronger the flour the greater the necessity for heavy or prolonged fermentation.

The fermentation of doughs is accomplished with what is known as either the sponge or straight dough methods, the method employed being optional, depending much upon shop construction and condition and to some extent upon the characteristics of the flour. By the sponge method only a portion of the total ingredients of the bread are fermented for a period of time usually representing 85 to 90% of the total fermentation period, after which the balance of the ingredients of the dough are added and the dough stage of fermentation sets in which stage consumes usually from 10 to 15% of the total fermentation period. When employing the straight dough method all ingredients of the bread or dough are fermented or aged from the beginning to the close of the fermentation time, the ageing being controlled by punching the doughs at certain periods during the fermenting.

It would be difficult to state just which method is being most employed, but as a whole it is quite probable that in most shops the straight dough method of fermentation is being used because of there being less space required and less handling of the doughs.

As to the results obtained from employing the two methods there is much difference of opinion. While there are many who contend that the sponge method produces a better bread than the straight dough process, or vice versa, there are yet others who believe that there is practically no difference in the products made from either method. In nearly every case the experience of the particular shop or condition will be the deciding factor, for in the end the ultimate question is to find that method which will produce proper and complete fermentation.

Generally speaking, should the chemist be aware of the quality of the flour with which he is to work, its characteristics and materials to be used and their amounts, as well as the conditions of the bakeshops under question, he can quite readily tell how much fermentation to use and the kind or process of ageing to employ.

And in the end there is but the one essential concerning any problem of fermentation confronting the cereal chemist which is to obtain the proper fermentation which must be had before the maximum good is to be obtained from any flour, and this applies whether it be perfection in color, flavor, size, or texture of loaf which is desired.

In conclusion may I again draw your attention to the imporant place which the cereal chemist holds in the relations existing between the baking and milling industries, and to be of greatest value to both or either industry he must understand as thoroughly as possible the practical problems confronting those industries. I have mentioned two important problems, I believe two of the most important problems, upon and around which will center most of your work with and for the baking industry whether your life work is with a baking or milling organization.

Meeting of Kansas Millers' Club, Chemists Round Table, April 14, 1923

Thirty-four were present at the meeting of the Kansas Chemists Round Table held at Hutchinson, Kansas, April 14, 1923. Of this number four were Mill Superintendents. Representation of Chemists was as follows:

Hutchinson 4, Ellinwood 1, Atchinson 1, Newton 1, Sterling 1, Wichita 3, Kingman 1, Winfield 1, Clay Center 1, Arkansas City 2, El Reno, Okla. 1, Salina 5, Lindsborg 1, Cherokee, Okla. 2.

Mill Superintendents from Wichita, Lindsborg, Halstead and Hutchinson were present.

President Schulz called the meeting to order at 10 A. M. and in the absence of the regular Secretary, J. R. Hess was appointed Secretary *pro tem.* L

Schulz opened the discussion on moisture determination by the vacuum oven method by presenting a bulletin entitled "Wheat Flour, Its Weight and Moisture Content" by Harry Snyder and published by the Millers National Federation, Chicago, Illinois.

Mr. Potts reported on some samples he had sent out for pretein determination. This brought up the subject of standardifation of solution which was discussed thoroughly. A letter was read concerning the methods recommended by the referee of the Official Agricultural Chemits, C. E. Mangels of the North Dakota Agricultural College.

The regular Secretary having entered at this time J. R. Hess relinquished his chair.

General discussion of moisture and ash occurred. Mr. Hess called attention to the fact that brushing out ash crucibles before weighing the flour into them caused static electricity, which attracted the finer particles of flour to form a fringe around the edge of the crucible, thereby making it easy for a loss of flour and ash to occur.

The question was raised whether the fermentation period of the flour could be safely guaranteed after determination of hydrogen-ion content and viscossity. Opinion was almost unanimous that there are too many factors governing the fermentation period to make it safe to guarantee a definite time. The length of time elapsing between the making of the flour and its use, storage conditions, the fact that hydrogen-ion content changes, the quality of all the ingredients of the dough, especially the condition and quality of yeast, are all factors which tend to make it difficult to set a definite fermentation period for a future date. A definite fermentation period can be set only for a specific flour at the time of determining hydrogen-ion content, and viscosity, but even then the quality and condition of the yeast, etc., may be rather unknown factors.

The fact was brought out that in the case of chlorine bleached flour the acidity factor of hydrogen-ion content is more nearly constant.

Mr. Vaupel was asked to tell about the Agene bleach used in his mill. He reported that it is very satisfactory when handled correctly and is one of the cheapest methods known. He stated that correct handling was merely a matter of agitation and rebolting after the bleach. There is no odor in the flour unless it is over-bleached or lays in the bleachers too long.

A short discussion of the Novadel process followed. This method is considered one of the best but it is too expensive.

Mr. Schulz mentioned the National Convention to be held in Chicago in June and urged that all Chemists of the Kansas Club be present.

Adjournment for lunch in the Rorabaugh-Wiley Tea Room was taken.

The Chemists reassembled at 1:20 P. M. Mr. H. M. Bainer of the Southwestern Wheat Improvement Association gave the principal address of the afternoon. The territory covered by his association includes Nebraska, Kansas, Oklahoma, Texas ,the eastern part of Colorado and part of Missouri. They consider only hard wheat. The association is supported mainly by the mills and partly by bankers, etc. It is hoped to later get the Federal Reserve Banks to co-operate. The work is carried on in co-operation with Agricultural Colleges, State Boards of Agriculture, Agricultural Experiment Stations and County Agents. Publicity is gained through newspapers, Clubs, etc.

Mr. Bainer stated that the Kansas Agricultural College is the most alive bunch in the United States in this line of work. They have done more work than any other on such subjects as the effects of fertilizer on soils, manure, weather conditions, soil conditions, influence of the nitrogen in the soil on the nitrogen in the wheat, and the influence of early crop rotation. Much of this information is still in data form not having as yet been arranged for publication.

The problem before the Association is to get the Federal Department of Agriculture interested enough to get an appropriation to carry on the work of getting the farmer interested in the gowing of better quality of wheat. The big difficulty is how to determine the quality of wheat through protein and moisture content before the grain firms buy or when it is stored in the small elevators with few bins. When the same price is given for poor wheat as for good there is nothing to stimulate the farmer into growing good wheat on the protein and moisture analysis basis.

Red Turkey wheat is considered the best hard winter wheat. However, Kanred outyields Turkey and while it may be inferior to the old fashioned Turkey, it is necessary to make the best of it, especially out here where Kanred of good quality can be raised.

Mr. Bainer said that he believed that most people were prejudiced against Kanred. He hopes in the next crop period to choose fields in different parts of the state where both Kanred and Turkey have been grown under similar conditions and take composite samples of these wheats for analysis and baking tests to determine the superiority of Kanred or Turkey.

Kanred wheat can be distinguished from Turkey only when growing in the field. Kanred from eastern Kansas is very yellow; from western Kansas, dark. Higher ground gives a darker berry; sandy or yellow soil, a yellow berry. When there is a high aveage yield there is a high protein of good quality. Shriveled wheat gives a high protein but is not good quality. In a dry year there is less wheat but better protein. As a rule, as protein runs up yield runs down and vice versa. Quality improves with yield. Therefore, higher protein must be controlled by fertilizers, etc., and care of the wheat before and after harvest. The impression is that Kanred goes to yellow berry quicker than Turkey does but this has not been proven. We should do all we can against spring wheat.

Mr. Bainer suggested that inspectors under federal control should be placed in every county to enable the small wheat buyers to buy wheat on a quality basis.

Mr. Mann and Mr. Hess were appointed a committee to draw up a resolution to submit to Mr. Bainer for recommendation to the Kansas United States Senators.

As Mr. Schulz had to leave, J. R. Hess was asked to take the chair.

Mr. Vaupel gave a talk on comparison of Black Hull wheat to Kanred and Turkey wheat and exhibited a loaf of bread baked from Black Hull and one baked from Red Turkey. He reported that Black Hull flour had an absorption of only 56% to 57% while Kanred and Turkey had 63%. The behavior of Black Hull dough did not vary whether the protein content was 10% or 14%. The dough slacked on fermentation, had poor absorption, poor expansion and poor volume. The loaf from Turkey flour with 63% absorption gave 2360 c. c. volume, while that from Black Hull with 58% absorption, gave 1800 c. c. volume. Black Hull is considered by some to be a dark, soft wheat.

Mr. Vaupel presented a table of general interest, which is included at the end of these minutes.

Mr. Morgan of Newton stated that in his opinion Black Hull was better wheat than Kanred by far, but not as good as Turkey. Mr. Bainer called attention to the fact that there are different conditions in Kansas than in Oklahoma and that a comparison of the kinds of wheat as applied to one state, probably could not be applied to another state.

The question of poor yeast was brought up. Numerous Chemists mentioned that they had had trouble getting good yeast lately and that the tendency of bakers was to blame the flour when in fact the yeast was what caused their trouble. It was decided to have a Fleischman man present at the next meeting to be held in Wichita sometime next autumn and have him give us a talk on yeast. There is also to be a talk on the effect of Novadel bleaching in general and especially on hydrogen-ion content and acidity.

The taik on the microscope omitted at the Hutchinson meeting because of the illness of Mr. Dupray will probably be given at the Wichita meeting.

Adjournment.

OKLAHOMA A. & M. EXPERIMENT STATION SAMPLES

By H. F. Vaupel, Chemist, El Reno Mill and Elevator Co.

1	Fullcaster	12.52	11.4	56.8	3 Mixed
2	Early R. Clausen	13.56	11.8	53.0	5 Red Winter
3	Dietz	14.68	12.2	56.0	3 Red Winter
6	Fultz	13.08	11.2	56.2	3 Red Winter
7	Reliable	13.24	12.1	56.2	3 Mixed
8	Harvest King	13.44	11.2	55.2	4 Red Winter
10	11c x la	15.00	12.0	54.5	4 Red Winter
11	Miracle	14.04	12.0	56.4	3 Red Winter
12	Hickman	13.72	11.4	56.8	3 Red Winter
13	Sibley's New Golden	1 3.96	11.6	55.3	4 Hard Winter
15	Turkey Red	15.08	12.1	53.0	5 Hard Winter
16	Beechwood Hybrid	13.52	12.0	55.7	4 Red Winter
17	Kanred	15.24	11.8	53.0	5 Dk Hd Winter
18	Early Ripe	13.80	11.7	55.5	4 Red Winter
20	Michigan Wonder	13.56	11.6	56.3	3 Red Winter
21	Malakov	14.04	12.5	52.4	5 Hard Winter
22	Burbank's Super	13.20	12.5	52.4	5 Hard Winter
23	Red Rock	13.64	11.1	51.2	5 Red Winter
24	Harvest Queen	13.24	11.8	54.6	4 Dk Hd Winter
25	Valley	12.68	11.8	56.2	3 Red Winter
26	Michigan Amber	13.72	11.6	56.6	3 Mixed
28	Black Hull	13.96	12.2	56.0	3 Red Winter
31	Black Hull	13.80	11.6	57.4	3 Hard Winter
			11.6	58.1	2 Hard Winter

The samples were grown on the Oklahoma A. & M. experimental plots at Stillwater. Stillwater may be considered to be a soft wheat section for Oklahoma, although considerable hard wheat is grown in this vicinity.

The following is a brief history of the plots on which these varieties were grown:

In the winter of 1919 and 1920 about 6 or 8 tons of barnyard fertilizer per acre were applied tothe land on which the varieties of wheat were grown this past season. In the fall of 1920 some of Burbank's wheat which was secured from Mr. Scott, of Oklahoma City, was sown on these plots. This wheat was harvested the first part of June 1921, following which cowpeas were sown as a catch crop. This crop did not mature; however, a growth of about 6 or 8 inches of cowpeas was plowed under the first part of September. The soil was thoroughly disked and packed. In the fall of 1921 the varieties of wheat were sown on this land. Previous to the winter of 1919 and 1920 Sudan grass was grown on this land and in 1918 kafir corn. In the season 1920 Sudan grass was grown on the plots. From this cropping system there is nothing unusual in regard to it unless it be the light application of barnyard manure during the winter of 1919 and 1920 and the small growth of cowpeas as a catch crop during the summer of 1921. While here has been no definite rotation established for this series, nevertheless, we believe the rotation of crops used on the farm have at least a little to do with the behavior of wheat.

Chemists Round Table,
H. L .Lentz, Secretary.

NOTICE

The Methods of Analysis of The American Association of Cereal Chemists is now available.

Copies can be secured from the Secretary, Mr. A. A. Jones, The Hoyland Flour Mills Co., 608 New England Building, Kansas City, Mo.

THE JOURNAL OF THE AMERICAN ASSOCIATION OF CEREAL CHEMISTS

Reaches over 1000 millers and chemists. Does your sales appeal enter this field?

For advertising space, rates, particulars, address R. S. Herman, Business Manager, 2023 Central Ave., Kansas City, Kansas.

ATTENTION: THE MILLER

Are you seeking a reliable and capable chemist? If you are, write the Editor of this Journal, as he usually has a list of available men, their qualifications, etc. Let us know what you require, approximate salary, etc.

ATTENTION: CHEMISTS

If you are looking for a position send the editor your name, address, experience, education and any other information you think necessary and we will give you information concerning positions open.

Address: J. R. Hess, Editor, The Journal of the American Association of Cereal Chemists, 318 Avenue B West, Hutchinson, Kansas.